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Monitoring System and Installation Plan for Operable Unit 3-13, Group 4, Perched Water Well Installation

INEEL
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ABSTRACT

This Monitoring System and Installation Plan provides the strategy for supporting and implementing the Operable Unit 3-13, Group 4, Perched Water remedial action at the Idaho Nuclear Technology and Engineering Center (INTEC). The Comprehensive Environmental Response, Compensation and Liability Act, Group 4, remedial action was divided into two phases. Phase I consisted of well installations, baseline sampling while the percolation ponds at INTEC were in operation, and a tracer study. Activities under Phase I were completed and the results are described in *Phase I Monitoring Well and Tracer Study Report for OU 3-13, Group 4, Perched Water* (DOE-ID 2003). Activities included in Phase II, the focus of this Work Plan, consist of (a) routine sampling and analysis, (b) installation of well monitoring instrumentation, (c) geochemistry sampling and analysis, and (d) an INTEC water balance engineering study. Phase II activities may also include well installation. This Work Plan presents the design basis and data quality objectives that were developed based on an evaluation of remedial action requirements set forth in the Operable Unit 3-13, Record of Decision and knowledge obtained from Phase I activities. Summaries of the primary remedial action design elements are discussed, including the Geochemical Study Field Sampling Plan and the Long-Term Monitoring Plan. The Field Sample Plan was developed to determine sources of perched water in the northern part of INTEC. The Long-Term Monitoring Plan was developed for long-term monitoring of perched water systems to determine the effectiveness of the Group 4 remedial actions. This Work Plan also presents the supporting documentation required for performing the remedial action, including the project Health and Safety Plan, Waste Management Plan, project schedule and cost estimate, Data Management Plan, and Quality Assurance Project Plan.

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ACRONYMS

AA	alternative action
amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirements
BBWI	Bechtel BWXT Idaho, LLC
bgs	below ground surface
BLR	Big Lost River
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	*Code of Federal Regulation*
COC	contaminant of concern
CPP	Chemical Processing Plant
DOE	Department of Energy
DOE-ID	Department of Energy Idaho Operations Office
DQO	data quality objective
DR	decision rule
DS	decision statement
EPA	Environmental Protection Agency
FFA/CO	Federal Facilities Agreement and Consent Order
FSP	Field Sampling Plan
FY	fiscal year
HASP	Health and Safety Plan
HI	hazard index
HWMA	Hazardous Waste Management Act
IDAPA	Idaho Air Pollution Act
IDEQ	Idaho Department of Environmental Quality
INEEL	Idaho National Engineering and Environmental Laboratory

INTEC	Idaho Nuclear Technology and Engineering Center
LSIT	large scale infiltration test
MCL	maximum contaminant level
MSIP	Monitoring System and Installation Plan
MW	monitoring well
OU	operable unit
OUL	Ozark Underground Laboratory
PSQ	principal study question
PW	perched water
QAPjP	Quality Assurance Project Plan
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RD/RA	remedial design/remedial action
RG	remedial goal
RI/BRA	Remedial Investigation/Baseline Risk Assessment
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SOW	Statement of Work
SRPA	Snake River Plain Aquifer
TBC	to be considered
TRA	Test Reactor Area
USGS	United States Geological Survey
WAG	Waste Area Group
WCF	Waste Calcining Facility

Monitoring System and Installation Plan for Operable Unit 3-13, Group 4, Perched Water Well Installation

1. INTRODUCTION

The Idaho National Engineering and Environmental Laboratory (INEEL) is divided into 10 waste area groups (WAGs) to better manage environmental operations mandated under a Federal Facility Agreement and Consent Order (FFA/CO) (Department of Energy-Idaho Operations Office [DOE-ID] 1991). The Idaho Nuclear Technology and Engineering Center (INTEC), formerly the Idaho Chemical Processing Plant (CPP), is designated as WAG 3. WAG 3 was divided into operable units (OUs) comprised of individual containment release sites. Operable Unit 3-13 encompasses the entire INTEC facility.

Operable Unit 3-13 was investigated to identify potential contaminant releases and exposure pathways to the environment from individual sites as well as the cumulative effects of related sites. Ninety-nine release sites were identified in the OU 3-13 Remedial Investigation/Feasibility Study (RI/FS), of which, 46 were shown to have a potential risk to human health or the environment (DOE-ID 1997a). A new operable unit, OU 3-14, was created specifically to address activities at the tank farm area where special actions will be required. The 46 sites were divided into seven groupings with shared characteristics or common contaminant sources, contaminants of concern (COCs), accessibility, or geographic proximity. The OU 3-13, Record of Decision (ROD) (DOE-ID 1999) identifies remedial design/remedial action (RD/RA) objectives for each of the seven groups. The seven groups include the following:

- Tank Farm Soils (Group 1)
- Soils Under Buildings and Structures (Group 2)
- Other Surface Soils (Group 3)
- Perched Water (Group 4)
- Snake River Plain Aquifer (Group 5)
- Buried Gas Cylinders (Group 6)
- SFE-20 Hot Waste Tank System (Group 7).

The Final ROD for OU 3-13 was signed in October 1999 (DOE-ID 1999). This comprehensive ROD presents the selected remedial actions for the seven groups, including Group 4 perched water instrumentation to assess the perched water drain-out and potential contaminant flux into the Snake River Plain Aquifer (SRPA).

This Monitoring System and Installation Plan (MSIP) identifies and describes in detail the work elements required to implement the selected remedies presented in the ROD, and provides a detailed project budget and work schedule, including FFA/CO enforceable milestones. The results of the Phase I well installation, sampling and tracer study are described in *Phase I Monitoring Well and Tracer Study Report for OU 3-13, Group 4, Perched Water* (DOE-ID 2003). The Monitoring Report/Decision Summary Report, a primary document, will be produced using data from Phase I and II activities to document the data, rationale, and justification for decisions concerning whether a third phase of contingent remedial actions is needed subsequent to the completion of Phase II activities. An updated Long-Term Monitoring Plan will be included as a part of this report. This report will function as the Remedial Action Report for Group 4 activities.

1.1 Regulatory Background

Under the FFA/CO, the U.S. Environmental Protection Agency (EPA), the Idaho Department of Environmental Quality (IDEQ), and the U.S. Department of Energy (DOE) (collectively known as the Agencies) are directing cleanup activities to reduce human health and environmental risks to acceptable levels at INTEC. Per the FFA/CO, INTEC is designated as WAG 3. In order to facilitate remediation of INTEC, WAG 3 was further divided into OUs comprised of individual contaminant release sites.

Several phases of investigation have been performed at the WAG 3 OUs. A comprehensive RI/FS (DOE-ID 1997a, 1997b, 1998) was conducted for OU 3-13 to determine the nature and extent of contamination and corresponding potential risk to human health and the environment under various exposure pathways and scenarios. Based on the RI/FS results, INTEC release sites were further segregated into seven groups based on COCs, accessibility, or geographic proximity, to allow development of remedial action alternatives. The INTEC perched water (PW) was designated as Group 4 in the OU 3-13 ROD.

The INTEC PW does not currently pose a direct human health and/or environmental threat. This perched water exists primarily as a result of INTEC water usage. The effect of the several potential sources are being evaluated as part of this plan, including the percolation ponds, the sewage treatment infiltration galleries, and the Big Lost River (BLR). The perched water is not used as a source of drinking water and is expected to disappear when INTEC operations cease. However, perched water does pose a threat as a contaminant transport pathway to the SRPA. The perched water zone may impact SRPA groundwater quality because it is a contaminant transport pathway between contaminated surface soils and the SRPA. Although a future water supply well screened in the perched water is not capable of providing sufficient water for domestic use purposes, restrictions will be required to prevent any future attempts to use perched water after 2095 when INEEL-wide institutional controls are projected to end. The remedial action objectives (RAOs) for perched water, as stated in the ROD (DOE-ID 1999) are as follows:

1. *Prevent migration of radionuclides from perched water in concentrations that would cause SRPA groundwater outside the INTEC security fence to exceed a cumulative carcinogenic risk of* 1×10^{-4}, *a total hazard index (HI) of 1, or applicable State of Idaho groundwater quality standards such as maximum contaminant levels (MCLs) in 2095 and beyond.*

2. *Prevent excavations into and drilling through the contaminated earth materials remaining after the desaturation of the perched water, to prevent exposing the public to a cumulative carcinogenic risk of* 1×10^{-4}, *a total HI of 1, and protection of the SRPA to meet Objective 3a listed above.*

A response action is necessary to minimize or eliminate the leaching and transport of contaminants from the perched water to the SRPA and to prevent future perched water use.

1.2 Selected Remedy

The selected remedy for the Group 4, Perched Water is institutional controls with aquifer recharge control. As described and defined by the RD/RA SOW, this remedy includes the following:

1. *Implement institutional controls (to include a DOE-ID Directive limiting access) to prevent perched water use while INTEC operations continue and to prevent future drilling into or through the perched zone (through noticing this restriction to local county governments, Sho-Ban Tribal Council, General Services Administration, Bureau of Land Management, and other agencies as necessary).*

   Implementation: This remedy is being implemented through Institutional Controls Projects identified and described in the OU 3-13 RD/RA Statement of Work (SOW).

2. *Implement remedies to control surface water recharge to perched water beneath INTEC by specifically taking the existing INTEC percolation ponds, which are estimated to contribute ~ 70% of the perched water recharge, out of service. Limiting infiltration to the perched water will minimize potential releases to the SRPA by reducing the volume of water available for contaminant transport. Design, construct, and operate replacement ponds outside of the INTEC perched water area following the removal of the existing INTEC percolation ponds from service. The replacement percolation ponds were sited ~ 3,048 m (10,000 ft) southwest of INTEC and became operational in August 2002.*

   Implementation: This remedy is being implemented through the INTEC Service Wastewater Discharge Facility Project (INEEL/EXT-99-00904).

3. *In addition, minimize recharge to the perched water from lawn irrigation, and lining the BLR segment contributing to the INTEC perched water zones, if additional infiltration controls are necessary. Implement additional infiltration controls if the recession of the Perched Water zone does not occur as predicted by the RI/FS vadose zone model within five years of removing the percolation ponds. If implementation of the additional infiltration controls is necessary, implement as a second phase to the Group 4 remedy.*

   Implementation: A decision on whether this remedy is needed will be based on data collected during the five years of monitoring following the relocation of the percolation ponds. This remedy may require an Explanation of Significant Difference to the OU 3-13 ROD and is not included in the RD/RA SOW.

4. *Measure moisture content and COC concentration(s) in the perched water zones to determine if water contents and contaminant fluxes are decreasing as predicted. Also use these data to verify the OU 3-13 vadose zone model and determine potential impacts to the SRPA.*

   Implementation: This MSIP describes and defines the activities intended to meet item number 4 of the remedy for Group 4. The MSIP will measure moisture content and COC concentrations in the perched water to determine if water contents and contaminant fluxes are decreasing as predicted by the OU 3-13 vadose zone model and to provide aquifer recharge control from the INTEC perched water bodies. These data will then be used to determine potential impacts to the SRPA. Data collected and analyzed will be used to determine the need for additional infiltration controls beyond the scope of this MSIP.

1.3 Scope

The Group 4 remedial action requires relocation of the INTEC percolation ponds. The INTEC percolation ponds were relocated in August 2002. Contingent recharge controls may also be implemented if the relocation of the percolation ponds is determined insufficient to meet the Group 4 RAOs. The OU 3-13 ROD further requires that five years after relocation of the percolation ponds, a decision will be made whether to apply the contingent recharge controls based upon the analysis of the five years of monitoring and predictions of the perched water drain-out until 2095. Results of the current remedial action and any contingent remedial actions, if applied, will be reevaluated every five years in the Comprehensive Environmental Response, and Compensation and Liability Act (CERCLA) five-year review process, for a minimum of 15 additional years.

Group 4 Phase II, as described in this work plan and associated monitoring plans, along with the results from Phase I will take this project to the point of the initial decision regarding contingent remedial action. This initial decision will be made five years after the percolation pond relocation. This Work Plan describes sampling and analysis activities and possible well installation activities associated with Phase II. Following the initial five years of monitoring the effects of percolation pond relocation, a Monitoring Report/Decision Summary will be prepared that documents monitoring data, rationale, and justification for the decision about whether there is a need for contingent remedial action.

The scope for these phases is described in greater detail in Sections 4 and 5 of this report and the attached Phase I and Phase II sampling plans. A logic diagram which describes the flow of activities for Phase II is presented in Figure 1-1.

1.3.1 Other Projects Implementing Remedy Scope

There are other remedial action elements and monitoring programs related to Group 4 that are being addressed as projects separate from the SOW of this project. The specific tasks and the projects where they are being handled are shown below:

Implementation of institutional controls—This work scope is intended to prevent perched water use while INTEC operations continue and to prevent future drilling into or through the perched water zone. This project is being addressed as a part of the Site-wide INEEL institutional control plan.

Implementation of remedies to control surface water recharge—This work scope is intended to reduce the perched water beneath INTEC specifically by taking the existing INTEC percolation ponds out of service. These ponds were taken out of service when new percolation ponds located southwest of the facility were brought into service in August 2002. The design, construction, and operation of the replacement ponds were addressed by the OU 3-13 Service Waste Water Discharge Facility project.

OU 3-13, Group 5, SRPA Interim Action—The Group 5 activities related to Group 4's RAOs include monitoring of COC flux across and outside the INTEC security fence in the SRPA, as well as measuring COC concentrations both above and below the HI interbed. These data will be used in conjunction with the Group 4 data in determining if the Group 4 RAOs are being met and if further action is necessary.

OU 3-14, Tank Farm Soil and Groundwater RI/FS—The purpose of the OU 3-14 RI/FS is to gather additional information to support risk management decisions about contaminated soils in the tank farm at INTEC and groundwater within the INTEC security fence.

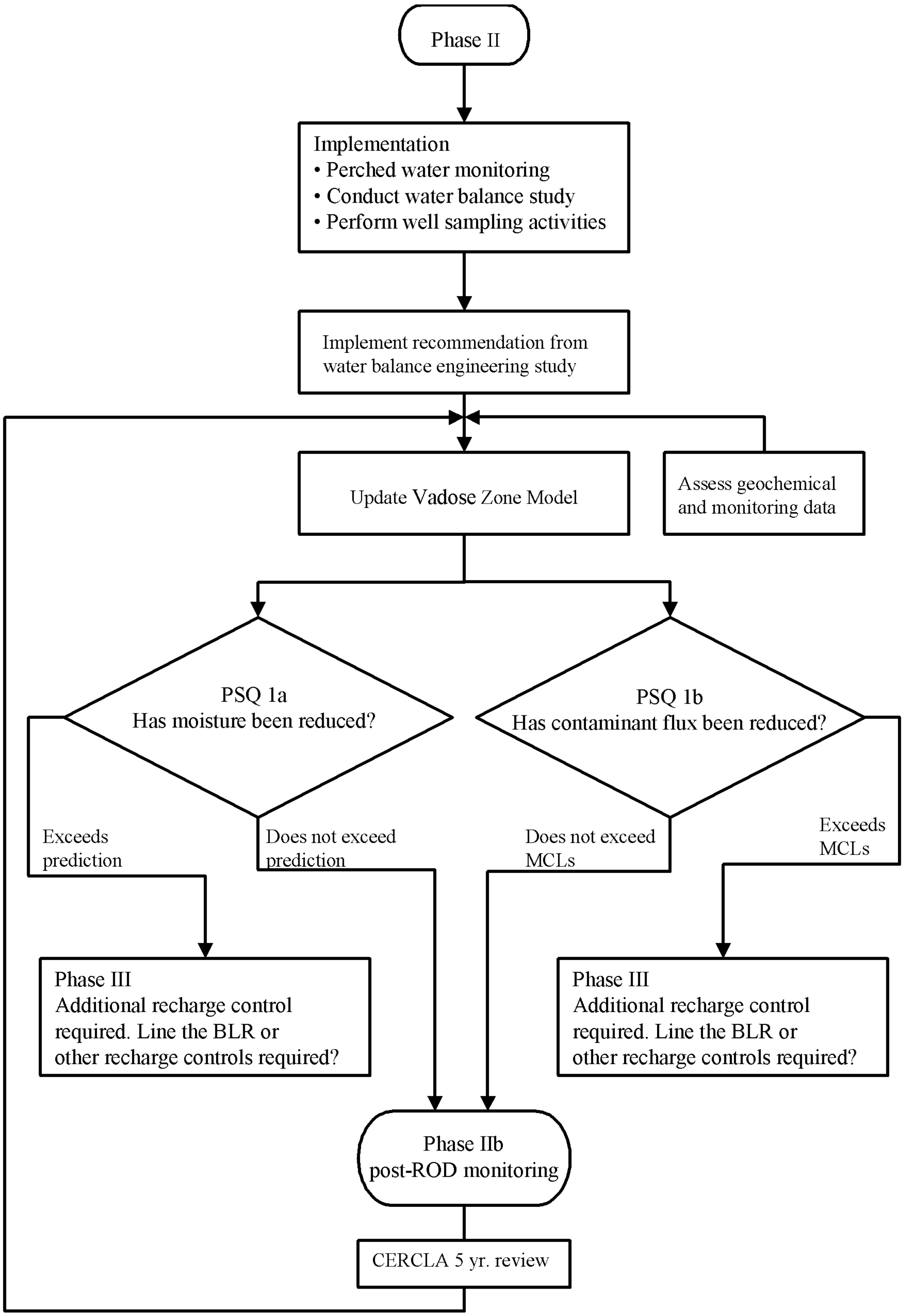

Figure 1-1. Logic diagram for Phase II Group 4 activities.

Waste Calcining Facility Postclosure Monitoring—The purpose of the Waste Calcining Facility (WCF) postclosure monitoring is to meet the Hazardous Waste Management Act/Resource Conservation and Recovery Act (HWMA/RCRA) groundwater monitoring requirements for this closed facility. A HWMA/RCRA postclosure permit will be issued for the former WCF in the late summer or fall of 2003. Because monitoring of this facility will utilize several of the same monitoring wells as Group 4 and the data generated will support the Group 4 decision, the field activities associated with the WCF postclosure monitoring program will be integrated with the Group 4 program in order to achieve efficiencies and cost savings in the areas of planning, sample collection, and waste management. Waste generated by the WCF monitoring program will be managed as CERCLA waste under the Group 4 Waste Management Plan.

The data from the above projects will be evaluated along with the data generated during the Group 4 monitoring activities. All these data will be analyzed together to determine the best possible path forward for the remediation of the INTEC vadose zone and groundwater.

1.4 MSIP Work Plan Organization

This MSIP was prepared following the methodology outlined in *Remedial Design and Remedial Action Guidance for the Idaho National Engineering and Environmental Laboratory* (DOE-ID 1994) and the requirements outlined in the Guidance on Expediting Remedial Design and Remedial Action (EPA 1990). The information developed and presented in this MSIP builds on the decisions made and documented in the OU 3-13 ROD (DOE-ID 1999) and the RD/RA SOW (DOE-ID 2000) for WAG 3, OU 3-13. The organization of the remainder of this MSIP is as follows:

- Section 2—Site Description and Background—Provides a description of the site geology, hydrology, and nature and extent of contamination

- Section 3—Design Criteria—Provides a description of the project and the design requirements and provisions for Phase II

- Section 4—Design Basis—Provides a status of the OU 3-13 ROD assumptions, a discussion of the modeling of the perched water and aquifer, and an evaluation of how the project applicable or relevant and appropriate requirements (ARARs) will be met

- Section 5—Remedial Design—Provides a discussion of the Phase II design elements

- Section 6—Remedial Action Work Plan—Provides an overview of the remedial action elements, any changes to the RD/RA SOW, an evaluation of performance measures, and a summation of the key guidance documents

- Section 7—Reporting—These reviews include CERCLA five-year reviews and the assessment of the drain-out of the perched water bodies five years after the percolation pond relocation.

- Section 8—References—Key documents that will be used or cited to guide and direct the execution of the project tasks.

2. SITE DESCRIPTION AND BACKGROUND

The site description and background, including the conceptual model of the perched water system at INTEC, are included in the following sections.

2.1 Site Background

The INEEL is a U.S. Government-owned facility managed by the U.S. DOE. The eastern boundary of the INEEL is located 52 km (32 mi) west of Idaho Falls, Idaho. The INEEL Site occupies approximately 2,305 km^2 (890 mi^2) of the northwestern portion of the Eastern Snake River Plain in southeast Idaho. The INTEC facility covers an area of approximately 0.39 km^2 (0.15 mi^2) and is located approximately 72.5 km (45 mi) from Idaho Falls, in the south-central area of the INEEL as shown in Figure 2-1.

INTEC has been in operation since 1952. The facility's original mission was to reprocess uranium from defense-related projects, and research and store spent nuclear fuel. The DOE phased out the reprocessing operations in 1992 and redirected the plant's mission to (1) receipt and temporary storage of spent nuclear fuel and other radioactive wastes for future disposition, (2) management of current and past wastes, and (3) performance of remedial actions.

The liquid waste generated from the past reprocessing activities is stored in an underground tank farm. The INTEC tank farm consists of eleven 1,135,624 L (300,000 gal) tanks, four 113,562 L (30,000 gal) tanks, four 68,137 L (18,000 gal) tanks, and associated equipment for the monitoring and control of waste transfers and tank parameters. One of the 1,135,624 L (300,000 gal) tanks serves as a spare tank and is always kept empty in the event of an emergency. The majority of wastes stored in the tank farm are raffinates generated during the first-, second-, and third-cycle fuel extraction processes.

Numerous CERCLA sites are located in the area of the tank farm and adjacent to the process equipment waste evaporator. Contaminants found in the interstitial soils of the tank farm are the result of accidental releases and leaks from process piping, valve boxes, sumps, and cross-contamination from operations and maintenance excavations. No evidence has been found to indicate that the waste tanks themselves have leaked. The contaminated soils at the tank farm comprise about 95% of the known contaminant inventory at INTEC. The final comprehensive RI/FS for OU 3-13 (DOE-ID 1997b) contains a complete discussion of the nature and extent of contamination.

The formation of the perched water zone is a result of natural BLR flows, facility water-line leaks, natural infiltration, steam discharge, sewage treatment lagoons, lawn irrigation, facility practices, and percolation pond operations. The percolation ponds came on line in a staggered manner. The pond directly south of the plant (Pond 1) began receiving service waste in 1984. The southeastern pond (Pond 2) came on line in 1986. The ponds have received all plant service wastewater since use of the injection well was discontinued in 1984. The ponds are filled on an annual alternating schedule. The two ponds received Resource Conservation and Recovery Act clean-closure equivalency for metals contamination in 1994 and 1995. This means that only the remaining radionuclides need to be addressed under CERCLA. The new percolation ponds constructed to the west of the present facility is part of Group 4, Phase 1 activities. The new percolation ponds were brought into service in August 2002.

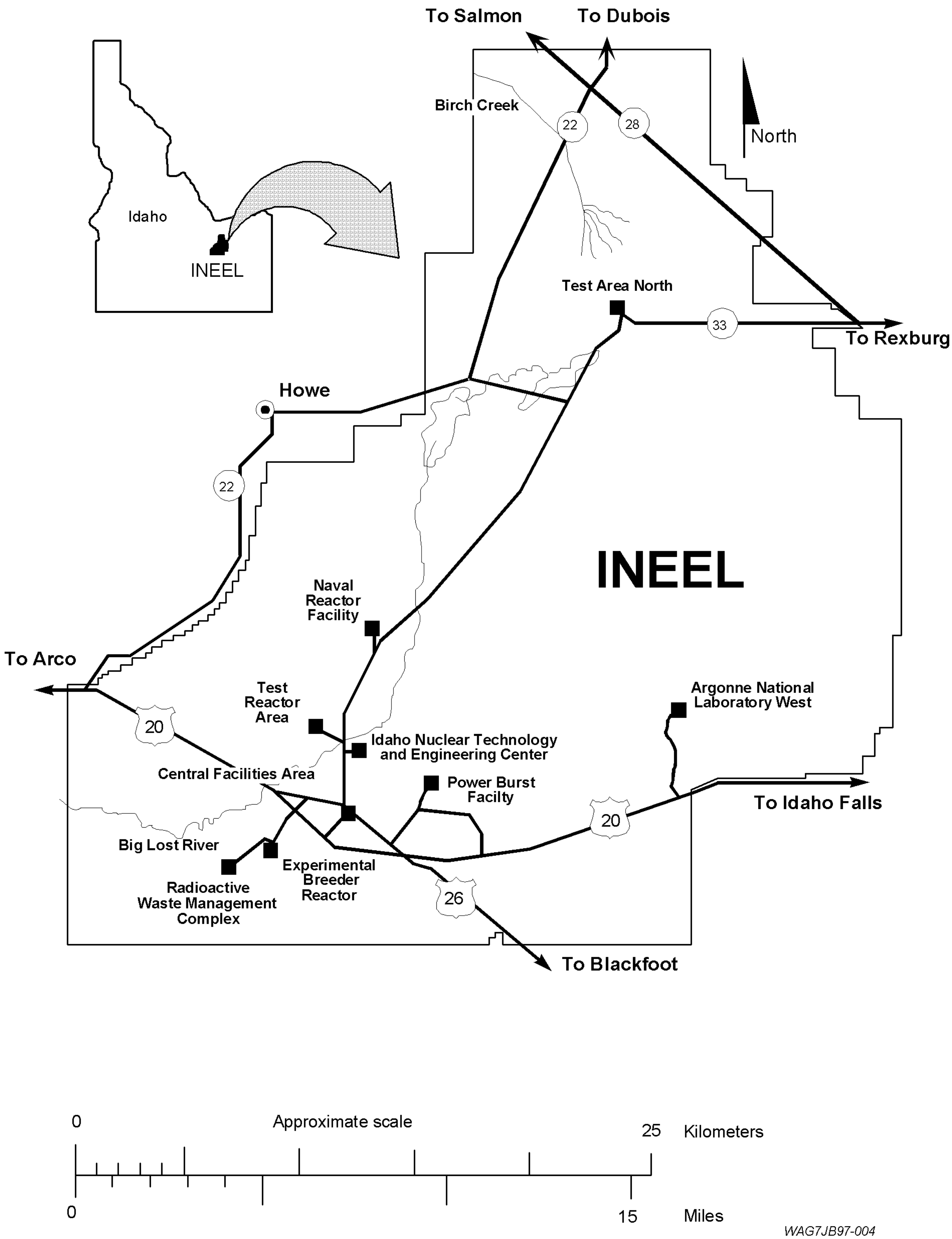

Figure 2-1. Map showing location of INTEC at the INEEL.

2.2 Conceptual Model

The conceptual model of the perched water system at INTEC has been updated to reflect the new data collected since the ROD went into effect in 1999. New wells drilled and installed at INTEC during Phase I have contributed to a better understanding of INTEC's subsurface stratigraphy and perched water system. The conceptual model focuses on the perched water systems, recharge sources, and contaminant transport through the vadose zone and the mechanisms that control contaminant distribution.

2.2.1 Geological and Hydrological Setting

INTEC is situated on the Snake River Plain within the boundaries of the INEEL. The elevation of INTEC is approximately 1,498 m (4,917 ft) amsl and receives an average of 22.1 cm (8.7 in.) of precipitation per year. Average snowfall per year is 70.1 cm (27.6 in.) that tends to accumulate over the winter months and is removed from areas such as roadways, sidewalks, and parking lots and placed in inactive areas until it melts in the spring. Net recharge from precipitation is estimated to be 4.1 cm/yr (1.6 in./yr), factoring in evaporation losses and precipitation events. The infiltration rate may be higher for localized areas due to impervious areas and drainage ditches leading to runoff infiltration areas.

The SRPA underlies INTEC and is located approximately 137 m (450 ft) bgs. Groundwater in the SRPA generally occurs under unconfined conditions but may be semiconfined or confined in local areas (Nace et al. 1959). Regional groundwater flow is generally south-southwest at average estimated velocities of 1.5 m/day (5 ft/day). The average groundwater velocity at INTEC is estimated at 3 m/day (10 ft/day) due to local hydraulic conditions (DOE-ID 1997a)

By design, INTEC is constructed on relatively thick, gravely, medium-to-coarse alluvial deposits that allows the burial of various utility lines, storage tanks, and other process-support infrastructure. The alluvium ranges from 7.6 to 18.2 m (25 to 60 ft) in thickness and rests on top of basalt flows that form a topographic basin in the area directly south of the tank farm. The surficial alluvium is underlain by a series of basalt flows and continuous-to-discontinuous sedimentary interbeds. Water that infiltrates downward through the alluvium and underlying transmissive basalts encounters zones of low-permeability interbed material or low-permeability basalt flows, creating local areas of high moisture content or saturation. If enough recharge water is present, perched water bodies form and persist.

Excavation of the alluvium to the surface of the basalt and backfilling associated with the construction of the underground tanks at INTEC likely resulted in areas of higher permeability. If a zone of low-permeable silt and clay was encountered during excavating, it was likely backfilled with the more permeable coarse alluvial material. This disturbed zone around the tank farm may have an increased infiltration rate for liquids moving through the surficial sediments.

The topographic depression in the top of the basalt located south and southwest of the tank farm area may act as a basin, collecting water infiltrating through the alluvium and directing that water toward the depression, provided the contact between the basalt and alluvium is relatively impermeable. If the basin is controlling the movement of groundwater in the subsurface, infiltration rates south of the tank farm area would increase and subsequently would have significant effects on the distribution of water in the perched systems below. Because of the existing contamination within the tank farm area, the basin in the basalt may act as a preferential pathway for contaminants originating in the tank farm area.

2.2.2 Perched Water Sources

Several sources of water perpetuate the perched water systems beneath INTEC. They include natural sources, such as precipitation infiltration and intermittent flows of the BLR, and artificial sources, such as the former INTEC percolation ponds, sewage treatment infiltration galleries, irrigation, water-line leaks, and steam vents. The locations of the former percolation ponds, BLR, and sewage treatment lagoons are shown on Figure 2-2. Based on past estimates of recharge, the former percolation ponds and the BLR contributed over 91% of the total recharge. Since the percolation ponds have been taken off line, a 70% reduction in recharge water has occurred at INTEC.

INTEC uses approximately 7.9 million L (2.1 million gal) of water per day. This water is supplied by two raw water wells and one potable water well located in the northern portion of INTEC. The primary water systems at INTEC include raw water, fire water, treated (softened) water, demineralized water, steam condensate, landscape watering, potable water, and service and sanitary waste systems. Piping systems outside of buildings are either buried or enclosed in utility tunnels. Based on the primary water systems, approximately 2.9 billion L (767 million gal) of water is distributed throughout 23 km (14 mi) of piping annually at INTEC. Past leaks, landscape irrigation, and steam condensate have contributed to the formation of perched water bodies in the subsurface and will likely continue to do so in the future.

During operation of the two former percolation ponds (the flow was diverted to a new percolation pond set in August 2002), they received an average of 5.7 million to 9.5 million L (1.5 million to 2.5 million gal) of service wastewater each day. The sewage treatment lagoons are aerated, arranged in series, and drain into secondary lagoons, which then overflow into infiltration trenches. An average flow to the sewage treatment lagoons is 159,000 L/day (42,000 gal/day), with a maximum capacity of 454,200 L/day (120,000 gal/day).

Recharge from the BLR has been an estimated amount, is not easily quantifiable, and occurs only when the BLR is flowing in the vicinity of INTEC. Recharge from the BLR can be substantial and ranges from 1 to 28 $ft^3/s/mi$ (Bennett 1990). As stated earlier, natural recharge from precipitation is believed to be 4.1 cm/yr (1.6 in./yr).

2.3 Perched Water Systems

Perched water bodies are significant because they increase the opportunity for contaminants to move both laterally and vertically in the vadose zone. This lateral water and contaminant movement in the vadose zone results in vertical migration rates that are spatially nonuniform beneath INTEC. Infiltration from the surface is assumed to move vertically through the basalt to an interbed. The water and contaminants migrate along the interbed and accumulate at interbed low points because the interbeds are sloped. This results in greater than average vertical water and contaminant fluxes in water accumulation areas and less than average vertical water and contaminant fluxes in the elevated portions of the interbed. Perched water bodies increase the complexity of flow and transport through the vadose zone.

2.3.1 Perched Water Systems

Two predominant perched water systems exist beneath INTEC. Other perched systems may exist across the INTEC site as isolated bodies of water caused by a localized source of recharge such as the intermittent shallow perched water observed around the CPP-603 basins. The two main perched water systems create the largest perched water bodies and are the focus of this model.

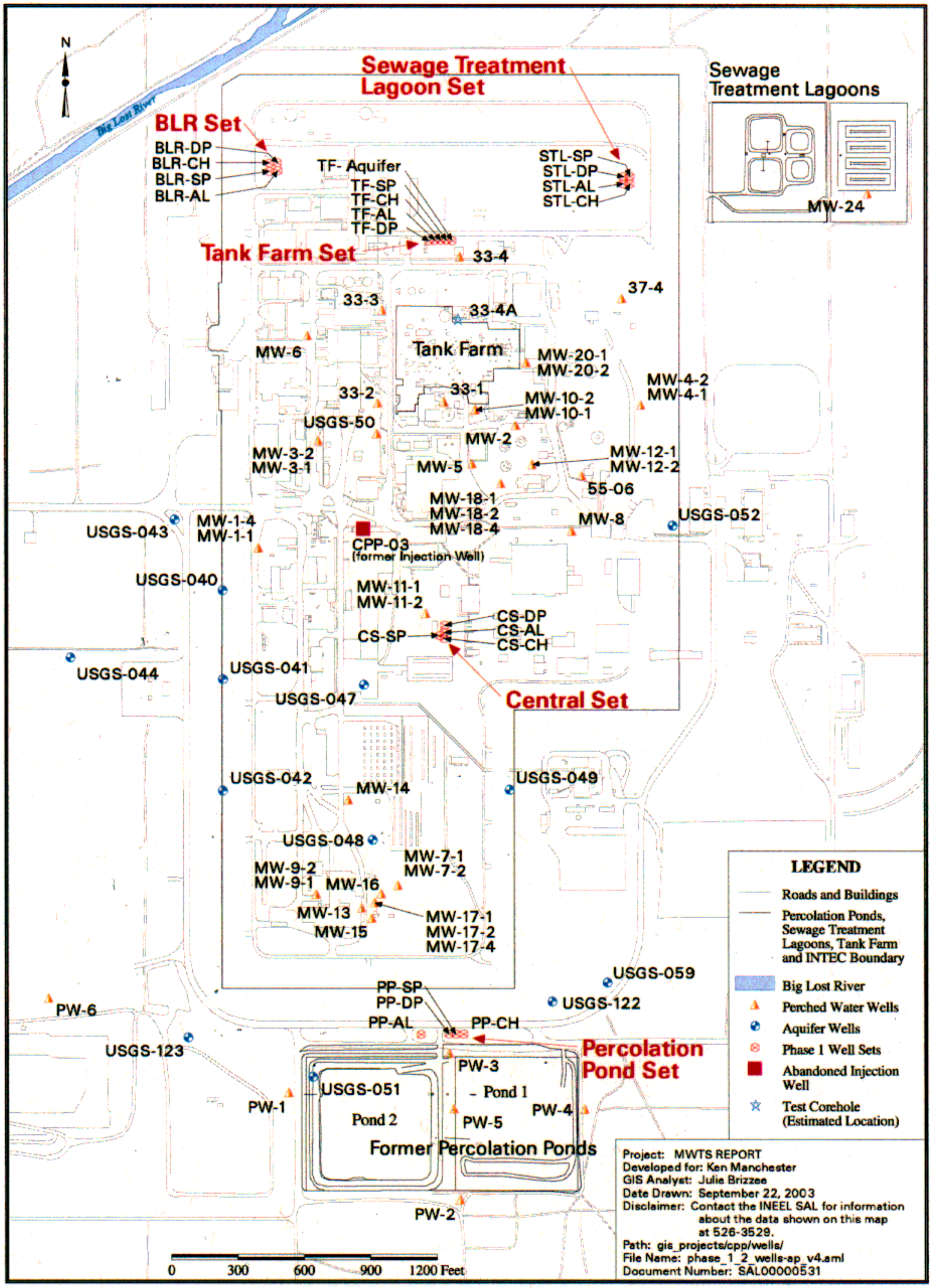

Figure 2-2. INTEC site map with new Phase I well locations.

2.3.1.1 Southern Perched Water System. The southern perched water system was created when disposing service wastewater began in 1984. With a continuous source of water, the southern perched water system began to form. Water infiltrating downward through the coarse alluvium first encountered fine-grained sediments immediately above the basalts, accumulated, and spread laterally a short distance. Shallow alluvial wells placed around the percolation ponds periodically had measurable standing water, depending on which of the two ponds was actively receiving water. As the water made its way through the fine sediment, it encountered the basalt and continued its downward path through vertical and horizontal fractures in the basalt flows.

Once the water encountered zones of lower permeability in the 110-ft interbed or impermeable basalt flows near that zone, the water again began to accumulate, forming the southern shallow perched water system. The northern extent of this water body was approximately the southern INTEC fence line. Shifts in the shallow perched water body occurred depending on which pond was receiving water. Water levels monitored in PW-1 and PW-4 typically had opposite trends. When water levels were high in PW-1, they were low in PW-4 and vice versa. As the shallow perched water spread laterally, it encountered zones of higher permeability and began to follow preferential pathways past and through the perching horizon. The lateral spreading along the perching horizon forced the water away from the source area, impacting a larger area.

After passing the 110-ft interbed zone, the water continued its way downward, encountering additional zones of low permeability and causing further lateral spreading of the perched water system. The next principal zone of low permeability was encountered at 76 m (250 ft) bgs, where an intermediate zone of perched water formed. Perched water collected in PP-CH at 73 m (240 ft) had the distinct percolation pond water geochemical signature. The northern extent of this perched water body was approximately 152.4 m (500 ft), based on the fact that MW-17-1, completed between 80 and 83 m (263 and 273 ft) bgs, remained dry.

After stair-stepping past the 250-ft interbed interval, percolation pond water continued its path downward toward the last major perching feature, the 380-ft interbed, before the SRPA. Again, water accumulated in this deep perched zone. Water samples collected from PP-DP, completed from 113.4 to 116.4 m (372 to 382 ft) bgs, again had the unique geochemical signature of percolation pond water. This perched water body extends slightly north of MW-17. Perched water collected from MW-17-4, completed as an open hole well from 109.4 to 116 m (359 to 381 ft) bgs, had slightly lower chloride concentrations, suggesting dilution effects. Once past this perching horizon, the percolation pond water moved downward into the SRPA, where it increased chloride concentrations in the groundwater. The outline of the chloride plume does not extend any farther north than MW-17; this plume acts as a good indicator of the southern perched water system footprint.

The southern perched water system, with a fairly steady source of recharge water, probably created a reasonably dynamic system where very little of the perched water was stagnant. When disposal switched from one pond to the other, stagnant zones may have formed but might have been short-lived once flow was switched again.

Since the service wastewater was diverted to the new percolation ponds 2 miles away in August 2002, the southern perched water system will begin to drain out. Preliminary water-level monitoring shows that water levels in the shallow perched zone are dropping and should continue to drop because the principal recharge source has been removed.

2.3.1.2 Northern Perched Water System. The northern perched water system is more complex than the southern perched water system in that recharge sources are not as apparent. The only measurable source of recharge comes from the sewage treatment lagoons. Geochemical data suggest numerous sources all combining to create the northern perched water system. Based on water-level analysis, recharge from the BLR is very likely when it flows but the recharge is difficult to quantify.

Water traveling through the surficial alluvium from each of the sources may perch on the alluvium/bedrock contact and begin to spread laterally if enough water is available. Based on limited monitoring of this potential perching mechanism, it does not represent a significant amount of perched water where saturated zones are intermittent and limited in size. However, when the BLR flows, this shallow perching horizon may play a significant part in moving the rapidly infiltrating water laterally from the BLR channel to the northern perched water area. The alluvium/basalt contact slopes to the southeast from the BLR channel toward a depression in the central part of INTEC. This depression in the basalt could accumulate water, including water from the BLR, increasing hydraulic head as it infiltrates the top of the basalt.

Water making its way past the alluvium/basalt contact continues down vertically with minor lateral spreading until it encounters the 110-ft interbed, where its vertical travel is impeded. The northern shallow perched water system then moves laterally and vertically to create upper, middle, and lower perched zones associated with the 110- and 140-ft interbeds and neighboring basalt flows. Radiological contamination in the perched water is typically higher in the upper and middle zones and lower in the lower perched zone associated with the 140-ft interbed. A significant fraction of perched water on the east side of the tank farm is believed to be originating from precipitation infiltration and/or leaking process pipes to account for the higher nitrate levels and the radiological contamination. The shallow perched water on the west side of the tank farm has lower nitrate concentrations, suggesting dilution of the perched water from a source having lower nitrate concentrations. One such source may be the lawn irrigation that takes place seasonally near MW-6. Shallow perched water in the vicinity of the sewage treatment lagoons generally has higher chloride concentrations than the shallow perched water found in the tank farm area. Nitrate concentrations are high but not as high as some of the shallow perched water near the tank farm.

The extent of the northern shallow perched water remains limited mainly to areas around the tank farm and sewage treatment lagoons. The shallow perched water in this area is likely discontinuous and may be intermittent, depending on the regularity and output of the different recharge sources. Shallow perched water is not observed in the TF-SP well completed from 44 to 45.7 m (145 to 150 ft) bgs northwest of Well 33-4, which generally has perched water. To the east, the shallow perched water extends at least as far as MW-4, where perched water is intermittent. Based on the intermittent presence of water in MW-8, the shallow perched zone develops to the southeast area around MW-8 at various times. To the west, the shallow perched zone extends past MW-6, but the lack of shallow monitoring wells farther to the west precludes determining the western extent of the water body. To the south, the shallow perched zone is intermittent, based on dry conditions in MW-18-2 (completed from 32 to 35 m [105 to 115 ft] bgs), saturated conditions in MW-11-2 (completed from 40 to 41.4 m [131 to 136 ft] bgs), and saturated conditions detected in the tensiometer CS-SP-1 at 37 m (122 ft) bgs.

Once the shallow perched water passes through the 110- to 140-ft interval, the water travels downward through several basalt flows and minor interbeds until it encounters the 380-ft interbed interval that tends to form the deep perched water zone. Small, discontinuous perched water bodies probably exist between the 140-ft interbed and the 380-ft interbed due to impermeable zones encountered by the water.

The northern deep perched water originates from several sources as determined from geochemical and isotope data. Water from BLR-DP (completed from 114.3 to 117.3 m [375 to 385 ft] bgs) appears to be a mixture of predominantly SRPA water with precipitation and/or BLR water. The high nitrate concentrations in wells MW-1-4 and USGS-50 suggest that the water in these wells originates from the east side of the tank farm; however, the stable isotope data from USGS-50 and MW-1-6 are similar to SRPA water and do not show the higher δD and $\delta^{18}O$ values from wells on the eastern side of the tank farm.

Northern deep perched water was found in MW-1-4, USGS-50, BLR-DP, MW-18-1, and STL-DP. The well at STL-DP was completed from 130.7 to 133.8 m (429 to 439 ft) bgs, which is considerably deeper than the other four wells and places the bottom of the well approximately 3 to 4.6 m (10 to 15 ft) above the top of the SRPA. Deep perched water was not observed in the deep perched wells installed at the tank farm well set or the central set. Based on this limited data set, estimating the extent and continuity of the deep perched water body is difficult.

2.3.2 Perched Water Contamination

Contamination in the perched water is described in terms of the northern and southern shallow perched water bodies and the deep perched zone using the results from the Phase I sampling conducted in 2001 (DOE-ID 2003). The most significant radionuclides in the northern shallow perched water body are Sr-90 and Tc-99. Tritium concentrations were higher in the deep perched wells and in the southern shallow well MW-17S. Wells around the percolation ponds generally had low concentrations of radionuclides. Chloride and nitrate were the principal nonradionuclide contaminants. Chloride was associated with the percolation ponds and to a lesser extent with the sewage treatment lagoons. Nitrate occurred at elevated concentrations in the shallow perched near the tank farm, the sewage treatment lagoons, and in some of the deep perched wells.

2.3.2.1 Northern Shallow Perched Water Contamination. The northern shallow perched water consists of an upper zone at approximately 110 ft and a lower zone at 140 ft. The highest radioactive contamination levels in the upper shallow perched water occur in the vicinity of the tank farm, especially in MW-2, MW-5, and 55-06. The most significant radionuclide measured in the upper perched water body is Sr-90. Low levels of tritium and Tc-99 were also detected in the upper perched water zone. Sr-90 was detected in all wells completed in the northern area of the upper perched water zone. The maximum historical Sr-90 concentrations were 320,000±3,000 pCi/L (MW-2) followed by 104,000±1,000 pCi/L (MW-5) and 66,300±600 pCi/L (CPP 55-06). In the 2001 sampling event, the maximum Sr-90 concentration detected was 136,000 pCi/L (MW-2) followed by 53,400 pCi/L (55-06) and 18,400 pCi/L (MW-5). MW-20 also contained elevated Sr-90 but was completed into the lower shallow perched zone. Tc-99 was also detected in the upper perched water. Historically, Tc-99 has been detected in all wells near the tank farm except MW-33-4 and MW-6. In 2001, the maximum Tc-99 concentration found in the upper shallow perched water zone is 94.2 pCi/L observed in Well 55-06. Higher concentration levels of Tc-99 have been detected in the lower portion of the shallow perched water. The Sr-90, Tc-99, and tritium concentrations were generally more than a third lower in 2001 than in 1995.

Nitrate was detected in 2001 above a federal primary drinking-water standard (MCL). Nitrate concentrations expressed as mg/L-nitrogen varied from 2.49 at MW-6 to 27 mg/L at Well 37-04. The distribution of nitrate in perched water shows that the nitrate contamination is mostly on the east side of the tank farm and at MW-24 located next to the sewage treatment lagoons. Nitrate concentrations in the perched wells in 2001 were lower than in 1995, when nitrate concentrations in the northern shallow perched water zone ranged from 3.5 to 35 mg/L-nitrogen. Maximum nitrate concentrations in the northern shallow perched water zone are well above the nitrate concentration (12.2 mg/L) in MW-24 next to the sewage treatment ponds.

Two wells (MW-10 and MW-20) are completed in water-bearing zones at depths of approximately 42 m (140 ft). The maximum historical concentrations for H-3, Sr-90, and Tc-99 from these wells are 38,000±50 pCi/L, 25,800±30 pCi/L, and 127±2 pCi/L respectively. In 2001, the maximum concentrations for H-3, Sr-90, and Tc-99 from these wells were 15,900±878 pCi/L, 20,700±2900 pCi/L, and 457±9.15 pCi/L, respectively A comparison of the water quality from the wells completed in the upper perched groundwater body (at approximately 33 m [110 ft]) to this deeper zone indicates an increase in both H-3 and Tc-99 concentrations and a decrease in the Sr-90 concentrations.

2.3.3 Southern Perched Water Contamination.

Wells that monitor the perched water quality in the southern upper perched water zone around Building CPP-603 include MW-7, -9, -13, -14, -15, -16, and -17. The only well sampled from the CPP-603 area was MW-17-2. Tritium was detected in the 55.5- to 58.5-m (182- to 192-ft) bgs zone at 40,400 pCi/L. Historically, Sr-90, U-234, and Tc-99 have also been detected in other CPP-603 wells when sufficient water was available for sampling (DOE-ID 1998).

Perched water in the former percolation pond area is monitored via six previously existing wells designated as PW-1 through PW-6. An additional well (PP-CH) was installed on the north boundary of the percolation ponds during the Group 4, Phase I, drilling program. Well PP-CH was installed in the lower shallow perched zone. The PW series wells have been monitored by the USGS since 1987. Wells PW-1, -2, -4, and -5 have been sampled quarterly since 1991 as part of the INTEC groundwater-monitoring program (INEL 1995).

Most of the historical radioactivity present in the PW-series wells is from tritium, with Sr-90 providing a secondary activity contribution. I-129 was also detected in the PW-series wells at concentrations less than 0.2 pCi/L and in PP-CH at 0.28 pCi/L. The concentration trends for Sr-90 and tritium in PW-1 from 1987 to 2001 show that increased Sr-90 and tritium activity occurred briefly in 1988, but since 1994, concentrations of both tritium and Sr-90 have remained relatively stable at low levels based on USGS monitoring data. Data from the 2001 sampling indicate tritium concentrations ranging from nondetects in most of the PW-series wells to a high of 737 pCi/L measured in PP-CH at a depth of 36.6 to 42.7 m (235 to 255 ft) bgs. Sr-90 concentrations ranged from nondetects to 2.37 pCi/L.

Relative to the SRPA water, high levels of chloride are associated with the PW-series wells and the new well PP-CH. The trend in chloride concentrations over time for PW-1 shows that chloride concentrations have declined from a high near 350 mg/L in 1993 to the present 150 mg/L, except for a spike in 1998. This pattern is similar to the results for the other PW-series wells. The decline in chloride concentrations since 1998 reflects the improvement in the quality of the service waste water that was discharged to the percolation ponds.

2.3.4 Deep Perched Water Contamination

Contamination in the deep portion of the vadose zone is different in composition from the upper perched zones. Prior to the drilling program of 2000/2001, the deep perched water was only monitored at INTEC through MW-1-4, MW-17-4, MW-18-1, and USGS-50, which were completed in water-bearing zones occurring at depths between 99.4 to 102.4 m (326 to 336 ft), 109.7 to 116.1 m (360 to 381 ft), 120.1 to 126.2 m (394 to 414 ft), and 109.7 to 123.4 m (360 to 405 ft), respectively. Prior to the 2001 Phase I sampling, two rounds of perched water samples have been collected from MW-1, and one round of perched water samples has been collected from MW-17 and MW-18. A substantial database concerning radioactive contaminants is available for the water quality from USGS-50. Results from these water-sampling events are described in the WAG 3 RI/FS Work Plan (INEL 1995).

Additional wells were constructed to obtain samples from the deep perched water during the Group 4, Phase I, drilling program of 2000/2001. One deep perched water well was constructed at each of the well set locations BLR-DP, CS-DP, STL-DP, TF-DP, and PP-DP (Figure 2-2).

The most significant radionuclide contaminants in the deep perched water are Sr-90 and tritium. Tc-99 and I-129 were also detected in 2001 at 52 pCi/L and 0.65 pCi/L, respectively, in the deep perched water at USGS-50. The tritium and I-129 concentrations in the deep perched water zone are likely associated with the waste stream that was directed to the INTEC injection well (Site CPP-23), where the vast majority of the associated radioactivity consisted of tritium (DOE-ID 1998). Wastewater was disposed to USGS-50 during the period of rehabilitation of the injection well from August to September 1971 and from December 1971 to February 1972. The maximum Sr-90 concentration detected in USGS-50 was 174 pCi/L. The maximum tritium concentrations detected in 2001 were 34,900 pCi/L detected in MW-18-1 followed by 32,900 pCi/L in USGS-50 and 12,600 pCi/L in MW-1-4.

Nitrate concentrations in the deep perched water zone range from 0.907 in BLR-DP to 60.3 mg/L-nitrogen at MW-1-4 in 2001.

2.4 Contaminants of Concern

The COCs identified in the OU 3-13 WAG 3 baseline risk assessment are primarily radionuclides. The perched water COCs are strontium-90 and tritium (H-3), cesium-137, iodine-129, plutonium isotopes (Pu-238, -239, -240, and -241), uranium isotopes (U-234, -235, and -238), Np-237, Am-241, and Tc-99. In addition, mercury (Hg) was identified as a COC. Contamination in the upper perched water results from contaminants being leached from surface sources while contamination in the lower perched water resulted from a combination of injection well failures and contaminant migration. By Agency request, hazardous volatile organic compounds were included in the Phase I sampling. Because volatile organic compounds sampling were not detected above MCLs in the baseline sampling event, sampling for volatile organic compounds has been discontinued. Geochemical sampling will include cations and anions.

3. DESIGN CRITERIA

The design requirements and provisions for the Group 4 remedial actions were developed to implement WAG-3 OU 3-13 ROD stipulations. The final design was arrived at through the data quality objective (DQO) process. The DQO process is a systematic planning tool based on the scientific method for establishing criteria for data quality and for developing data collection designs. The design criteria for the main components of Phase II activities are described below.

3.1 Phase I Results and Description of Phase II Activities

The following sections describe the results of the Phase I monitoring and the strategy for Phase II monitoring.

3.1.1 Phase I Results

The basic objective for the Phase I monitoring was to collect data regarding the hydrologic system at INTEC while the percolation ponds are still operating. A primary objective was to evaluate the hydrologic connection between recharge sources surrounding INTEC and the perched water observed in the subsurface beneath INTEC. The Phase I activities and results are reported in *Phase I Monitoring Well and Tracer Study Report for OU 3-13, Group 4, Perched Water* (DOE-ID 2003). The Phase I results are being used to revise the DQOs and finalize the Phase II monitoring plans and to support interpretation of the Phase II monitoring results.

3.1.2 Phase II Discussion

The basic objective for the Phase II monitoring is to collect data supporting the contingent remedial action decision and identify follow-on actions. Because the primary basis for the decision will be perched water drain-out and estimates of the COC flux to the SRPA outside the INTEC security fence through the year 2095, the Phase II monitoring program must include monitoring of both the moisture content and COC concentrations in the vadose zone, as well as sampling for COC concentrations in the vadose zone and SRPA beneath INTEC (inside the security fence). The Phase II objectives have been modified based on recommendations made in the Phase I report (DOE-ID 2003).

It should be noted that the Group 4 Phase II monitoring program does not include the sampling of SRPA water. Monitoring of the SRPA beneath INTEC is an important component of the Group 4 remedy and required to estimate the flux of COCs from the perched water to the SRPA outside the INTEC security fence. This is being performed under the Group 5 SRPA monitoring program. In order to meet the Group 4 data requirements, Wells USGS-40, -42, -47, -48, -49, -51, -52, -121, -122, -123, and MW-18 will require monitoring.

3.1.2.1 Well Installation. If determined to be necessary, the Phase II well installations will complete the monitoring well network to support the long-term monitoring program that will begin after the INTEC service wastewater percolation ponds are removed from service. The need for the Phase II well locations will be determined based on the results of the Phase II activities. Preliminary criteria for the selection of the Phase II well locations include placement near known areas of significant surface contamination such as the tank farm, placement near areas that will help define boundaries and connectivities of perched water bodies, and placement to support definition of zones of high COC concentrations in the subsurface. If determined to be necessary, the Phase II monitoring wells will also be used to further refine estimates of COC flux to the SRPA and will include skimmer wells completed at the top of the SRPA, as well as monitoring the shallow and deep perched water. If required by the WCF permit, any new wells drilled for WCF monitoring will also be used for Group 4 monitoring.

3.1.2.2 Long-Term Monitoring. The primary criterion for the Phase II long-term monitoring program is to provide sufficient data to evaluate the effectiveness of the Group 4 remedial action, evaluate whether the Group 4 RAOs will be met, and support the contingent remedial action decision 5 years after the percolation pond relocation. Because the decision will be based upon whether moisture contents and the COC flux have been reduced to meet RAOs, both moisture content and COC concentrations must be monitored during Phase II. Since there are several sources of recharge water, the Phase II monitoring well network must be sufficiently distributed to determine the effects of each recharge source on the migration of contaminants beneath INTEC. (Note: as discussed above, additional wells may be installed in Phase II to augment the monitoring well network that is determined necessary to evaluate the remedial action.) Finally, because the contingent remedial action decision must be made 5 years after relocation of the percolation ponds, the frequency of COC sampling activities and moisture monitoring should be appropriate to monitor trends which may be occurring during that 5 year period.

3.2 Group 4 Phase II Data Quality Objectives

The EPA developed the DQO process as a means to "improve the effectiveness, efficiency, and defensibility of decisions" used in the development of data collection designs (EPA 1994). The DQO table for Phase I activities is in Revision 0 of the MSIP (DOE-ID 2000). The DQO process is a systematic procedure for defining data collection criteria based on the scientific method. This process consists of seven iterative steps that yield a set of principal study questions and decision statements that must be answered to address a primary problem statement. The seven steps comprising the DQO process are listed below:

- Step 1: State the problem
- Step 2: Identify the decision
- Step 3: Identify the inputs to the decision
- Step 4: Define the study boundaries
- Step 5: Develop decision rules
- Step 6: Specify limits on the decision
- Step 7: Optimize the design for obtaining data.

The following sections present details on each of the DQO steps to be answered by the work conducted under this MSIP. The DQOs as discussed in the following sections have been negotiated and approved by the supervising agencies. Table 3-1 presents a summary of the DQO process for the Group 4 remediation goals.

3.2.1 State the Problem

The OU 3-13 ROD requires a determination of whether relocation of the percolation ponds is sufficient to meet the OU 3-13 Group 4 remediation goals. The ROD establishes two remediation goals for the perched water of (1) "reduce recharge to the perched water" and (2) "minimize migration of contaminants to the SRPA, so that SRPA groundwater outside of the current INTEC security fence meets the applicable State of Idaho groundwater standards by the year 2095" (DOE-ID 1999, Sec. 8.1.4, p 8-9).

. Inputs to the Decision:

he inputs to PSQ-1a are:

. Results from site monitoring activities performed under PSQ-1b, and -2 below

. Revision to WAG 3 RI/FS vadose zone numerical model incorporating updated site conceptual model information into an updated vadose zone model

. An engineering study to quantify recharge sources as a result of operation losses and planned discharges of water from the INTEC water distribution system, steam condensate drains, and sewage treatment system, and other operational practices

. An enhanced geochemical study of known recharge sources and the perched water bodies for stable isotopes, including nitrogen, to help in the identification of water sources contributing to perched water system.

he inputs to PSQ-1b are

. Spatially distributed matric potential measurements from tensiometers installed within each of the subsurface zones at INTEC

. WAG 3 revised vadose zone numerical model derived matric potential action levels for each of the same subsurface zones

. Moisture characteristic curves for interbed sediments

. Collection and chemical analysis for COCs of perched water samples from existing vadose zone monitoring wells

. Collection and chemical analysis for COC of water samples from new and existing lysimeters

. Measurement of water levels in existing vadose zone monitoring wells

. Collection and chemical analysis for COC of groundwater samples from new and existing monitoring wells installed in the SRPA

. Measurement of water levels in new and existing monitoring wells installed in the SRPA

. Recharge water source information for precipitation, BLR flows, and facility discharge volumes

0. Incorporation of monitoring data, collected during the 5 years following relocation of the percolation pond, into an updated WAG 3, OU 3-13 model and calculation of the predicted concentrations of COCs in the SRPA in year 2095 and beyond

1. Prediction of COC concentrations in the SRPA through 2095 and beyond

2. Risk predictions based on results of updated vadose zone model.

he inputs to PSQ-2 may include

. Inputs established under PSQ-1a and b, above

. Monitoring flow in the BLR [United States Geological Survey (USGS) data]

. Installing monitoring equipment in perched wells near the BLR.

4. Define the Study Boundaries

This study focuses on the transport of COCs from the vadose zone to the SRPA. Specifically excluded from this study is contamination of the surface soils (alluvium to top of basalt) at INTEC, which are covered under other programs. Existing and any new information about contamination in the alluvium will be used as an input to the Group 4 modeling. The physical boundaries of the study area are from the BLR (on the north) to the percolation ponds at the south end of INTEC. The east-west boundaries roughly correspond to the east-west perched water zones and include the sewage treatment lagoons and probably a portion of the BLR. At depth, the boundaries of the study area are from the top of basalt down and into the top of the SRPA.

The Group 4 remedial activities will also focus on identification of potential recharge sources for the northern perched water including the sewage treatment lagoons, leaks in facility infrastructure (water supply, fire, sewage lines, steam lines), lawn irrigation, and precipitation. The percolation ponds have been moved and the sewage treatment lagoons may be moved in the fall of 2003 (not part of the CERCLA remedial action).

To aid in the remedial action evaluation and based on the physical characteristics of the perched water bodies and locations of recharge sources, the vadose zone will be divided into a northern-upper, northern-lower, southern-upper, and southern lower perched water zones. The boundary between north and south will be marked by an east-west line across the southern end of the FAST Building (CPP-666). The boundary between the upper and lower perched water is placed at a depth of 200 ft between what is commonly referred to as the upper interbeds (110-140 ft) and lower interbeds (~380 ft). The division of the vadose zone into four discrete study areas allows for independent review of each of these areas as the remedial action progresses.

The Group 4 remedial activities will be undertaken in three phases. The purpose of the first phase was to obtain information and background data while the percolation ponds are working to establish compliance monitoring and will include installation of 15 wells, conducting a series of tracer tests, and monitoring moisture content and COC concentrations. The Phase I results are described in *Phase I Monitoring Well and Tracer Study Report for OU 3-13, Group 4, Perched Water* (DOE-ID 2003). The purpose of Phase II is to monitor the drain out of the perched water following relocation of the percolation ponds, to perform water-balance and enhanced geochemical studies to determine sources of perched water, and may include drilling additional wells. Phase III activities, if required, will be conducted to implement additional recharge controls (either lining of the BLR or other controls determined to be necessary) and long-term monitoring.

Lining of the BLR will require preparation of additional CERCLA documentation (e.g., Work Plan), modification to the SOW, and possibly, additional field investigations to support a Work Plan.

7. Optimize the Design

he design for the WAG-3 OU 3-13 Group 4 investigation will be implemented in phases. The proposed Phase I activities were described in a previous revision of the MSIP. A description of the ompleted Phase I activities is given in the MWTS Report (DOE-ID 2003). Phase II activities will include routine groundwater sampling and monitoring, an enhanced geochemical study and an ngineering study of the INTEC water systems to evaluate potential sources of perched water recharge.

he Phase II enhanced geochemical study will include sample collection from potential water sources such as the sewage plant effluent, ponded surface water in the spring, snow, water supply, steam ondensate discharge, and fire line water and monitoring wells in the northern part of INTEC. The enhanced geochemical sampling program is a 1-year program designed to monitor the influence rom various potential sources of perched water. Samples from the potential water sources will be analyzed for major cation and anions and for oxygen and hydrogen isotopic composition. Up to three team condensate samples will be collected from discharge conduits located near the tank farm. The steam conduits to be sampled will be guided by the results of the engineering study described elow. Up to three ponded surface water samples, if available, will be collected in the spring to evaluate the chemical signature of potential surface water infiltration. Up to three snow samples will be ollected in late February or March prior to spring snow melt and analyzed for oxygen and hydrogen isotopic ratios. The water supply, sewage plant effluent, and fire line water will be sampled uarterly for one year. The samples from the sewage treatment plant will be collected from the infiltration ponds. The water supply will be sampled after chlorination. Note that the sewage infiltration ond sampling may not occur if the sewage infiltration ponds are taken off-line prior initiation of this sampling program.

he enhanced geochemical study will include sampling wells near the tank farm up to four times over a period of one year for hydrogen and oxygen isotopic analysis, major cations, anions, and key adiological analytes including tritium and strontium-90. The wells in this geochemical study include 55-06, MW-5, MW-2, MW-20-2, MW-10-2, 37-4, MW-24, MW-1-4, USGS-50, 33-2, 33-3, and 3-4. The total number of samples will be determined by the probability of a significant spring infiltration event and whether there is flow in the BLR. If the BLR flows and if water-levels rise in the erched wells near the tank farm, a sampling event will occur to characterize the influence from the BLR on perched water chemistry and will analyze for anions, cations, tritium, and strontium-90.

Vells in northern part of INTEC will be instrumented with water-level, conductivity, and temperature probes to evaluate impacts from the BLR. Wells planned to be instrumented for evaluation of he impacts of the BLR will include TF-AL, TF-DP, TF-CH, BLR-AL, BLR-SP, BLR-DP, BLR-CH, 33-2, 33-3, 33-4, 37-4, MW-24, MW-1-4, MW-10-2, MW-5, and MW-2.

When the BLR flows, up to six samples will be collected from the BLR for hydrogen and oxygen isotopic and geochemical characterization including major anions and cations to characterize easonal variation in the composition of the BLR. This data, in combination with water-level and conductivity data will be used to evaluate the impact of the BLR on perched wells in the northern art of INTEC. Hydrogen and oxygen isotopic data will only be collected if the BLR is flowing during the period that other potential perched water sources are sampled for oxygen and hydrogen sotopic composition. If the BLR does not flow in Spring 2004, hydrogen and oxygen isotopic data will not be collected and wells will only be sampled for anions, cations, tritium, and strontium-90. One sampling event will occur after the BLR has been flowing for a period time. The wells to be sampled to evaluate the influence of the BLR include 55-06, MW-5, MW-2, MW-20-2, MW-10-2, 7-4, MW-4-2, MW-24, MW-1-4, USGS-50, STL-DP, BLR-DP, BLR-CH, BLR-AL, 33-2, 33-3, and 33-4 (Figure 2-2).

A sampling event for nitrogen and oxygen isotope ratios in nitrate for perched wells 55-06, MW-5, MW-2, MW-20-2, MW-10-2, 37-4, MW-4, MW-24, MW-1-4, USGS-50, STL-DP, CS-CH, 33-2, 3-3, and 33-4 will be conducted to evaluate the sources of elevated nitrate concentrations in the shallow and deep perched water wells in the northern part of INTEC. Potential nitrate sources include he sewage treatment lagoons and industrial source(s) such as the tank farm. Because nitrate concentrations are higher downgradient of INTEC than upgradient in the SRPA, samples should be ollected from wells USGS-121, USGS-47, USGS-112, USGS-77, USGS-123, USGS-52, and ICPP-MON-A-230 to evaluate potential impacts on the SRPA from perched water and contaminant flux rom the tank farm area or the sewage treatment lagoons.

he engineering study to quantify recharge sources will consist of two phases. The first phase will include (a) reviewing historical information (such as previous tracer studies to evaluate line leaks), b) identify new, existing, modified, and projected input and output water sources, (c) develop and recommend the methods for quantifying discharges, recharges, and flow rates from point sources nd nonpoint sources, and (d) make recommendations for minimizing recharge to perched water bodies in and surrounding INTEC. The engineering study will update and expand upon the ICPP Vater Inventory Study Project Summary Report (WINCO 1994). The engineering study will prepare a water balance for fire and raw water systems, potable and demineralized water systems, steam ondensate systems and sanitary sewer and service waste systems, landscaping systems, drains, basins, sewers, and other outlets. Since steam condensate systems may only be active during part of the ear, the analysis of the steam condensate discharge and line losses may have to be performed at a different time of year from the other water systems. The initial phase of the engineering study will valuate steam uses. Maps showing locations of water leaks or losses will be prepared. Recommendations for minimizing perched water recharge will also be made. The second phase of the ngineering study will be to evaluate and implement recommendations from the phase one report. A meeting will be held with the agencies to discuss and concur on the Phase II scope.

f the above described data are inconclusive, on recharge sources, then Phase II may also include installing additional well sets which may include an alluvial well (~45 ft below ground surface [bgs]), shallow perched water well (~120 to 140 ft bgs), a deep perched water well (~380 ft bgs), and an aquifer skimmer well (~450 ft bgs). Phase II may also include monitoring instrumentation installed n Phase I and II wells, monitoring water levels in all existing perched water wells, and COC and geochemical sampling of soil- and perched-water in new and existing wells. Except for the one year nhanced geochemistry study, COCs including any additional hazardous substances will be sampled for annually during Phase I and II until the decision on the need for further recharge control is nade (sometime after the 5 years following the relocation of the percolation ponds). Thereafter, they will be sampled for in 5-yr increments. Except for the one year enhanced geochemistry study, eochemistry samples will be collected initially (after completion of Phase I wells) and in years 2, 4, and 6 (percolation ponds were relocated in year 2).

Yearly sampling and monitoring the vadose zone wells will continue after the enhanced geochemical study during the 5 years following percolation pond removal. It is estimated that a network of bout 60 wells will be sampled, if water is present, annually for chemical analysis. Moisture data from the same well network will be collected daily during this part of the investigation. After the years, monitoring and sampling will continue in a reduced well network (~20 wells) at a reduced frequency. Phase II will also include collecting soil moisture tension data from the Phase I perched vater wells, collecting water samples from newly installed instrumentation as well as existing perched water wells and analyzing data for COCs and water geochemistry. COC analytes may include ritium, technetium-99, iodine-129, strontium-90, plutonium and uranium isotopes, mercury, and other hazardous constituents in addition to the COCs listed in the ROD.

If these goals are not met, then additional infiltration controls are required. Per the ROD, the next remedial action would be lining the BLR, if relocation of the percolation ponds is not successful in meeting the remediation goal.

Perched water at INTEC has been identified as two distinct areas, the northern perched water and southern perched water (DOE-ID 2003). Perched water is also differentiated between a shallow perched water zone (approximately 110 to 140 ft bgs) and a deep perched water zone (approximately 380 ft bgs).

For the DQO process, the problem can be stated this way: Is relocating the percolation ponds successful in meeting the OU 3-13, Group 4 remediation goals (that is, preventing migration of radionuclides from perched water in concentrations that would cause the SRPA groundwater to exceed drinking water standards in 2095), or are additional infiltration controls necessary?

3.2.2 Identify the Decisions

This step of the DQO process identifies the principal study questions (PSQs) that must be answered to effectively address the above-stated problem. The purpose of a PSQ is to identify key unknown conditions or unresolved issues that, when answered, provide a solution to the problem being investigated. The three PSQs for this project are listed in Table 3-1. The primary decision is to determine whether relocation of the percolation ponds is successful in preventing migration of radionuclides from perched water in concentrations that would cause the SRPA groundwater to exceed drinking water standards in 2095 and beyond. If relocation of the percolation ponds is insufficient to meet this goal, then additional recharge controls will be necessary, as stated in Section 8.1.4 of the ROD (DOE-ID 1999). Such actions are outside the scope of this MSIP. Evaluation of the success of relocation of the percolation ponds will be based upon whether the Group 4 remediation goals (DOE-ID 1999, Sec. 8.1.4, pg. 8-9) can be demonstrated as being met. To further assist in this evaluation, the vadose zone modeling conducted as part of the WAG 3, OU 3-13 RI/FS will be utilized.

3.2.3 Identify Inputs to the Decision

This step of the DQO process identifies the informational inputs that are required to answer the DSs identified above. The inputs for each PSQ are listed in Table 3-1.

3.2.4 Define the Boundaries of the Study

This study focuses on the transport of COCs from the vadose zone to the SRPA. Specifically excluded from this study is contamination of the surface soils from (alluvium to top of basalt) at INTEC which are covered under other programs. The physical boundaries of the study area are from the BLR on the north to the percolation ponds at the south end of INTEC. Additional boundaries for this study are defined in Table 3-1.

3.2.5 Develop a Decision Rule

This step of the DQO process brings together the previous outputs into a single statement describing the basis for choosing among the listed alternatives. The decision rule for each of the PSQs is given in Table 3-1.

3.2.6 Optimize the Design

The design for the OU 3-13 Group 4 investigation will be implemented in phases. These phases will build on each other, allowing the design of the monitoring program to be optimized through an improved understanding of site conditions. The Phase I results are described in *Phase I Monitoring Well and Tracer Study Report for OU 3-13, Group 4, Perched Water* (DOE-ID 2003). The Phase II activities are described in Table 3-1.

Following the completion of the initial five years of Phase II monitoring and completion of the Monitoring Report/Decision Summary for contingent remediation, it is expected that if the drain-out is occurring as predicted, the monitoring well network and sampling frequency will be reduced. The Monitoring Report/Decision Summary will present the subsequent monitoring plan for the period following the initial five years of Phase II monitoring.

3.3 Performance Standards

The performance of the Group 4, Perched Water, remedial action will be evaluated against the RAOs and RGs established in the WAG 3 OU3-13 ROD (DOE-ID 1999, Section 8) and discussed in the following sections.

3.3.1 Remedial Action Objectives

RAOs for OU 3-13 were developed in accordance with the National Contingency Plan and CERCLA RI/FS guidance. RAOs specify the contaminants and media of concern, potential exposure pathways, and RGs. RGs establish acceptable exposure levels that are protective of human health and the environment. Factors that are considered in establishing RGs are outlined in 40 CFR 300.430. RAOs are specific risk criteria that take into consideration the assumed future land uses at INTEC. The RAOs are primarily based on the results of the baseline risk assessment and ARARs.

The INTEC land use assumptions used to develop the RAOs include industrial use prior to 2095 and potential residential use after that time. Other assumptions used to develop the RAOs, as listed in the ROD, include the following:

- The INTEC facility will be used as an industrial facility up to the year 2095. During the period of DOE operations, expected to last to at least 2045, this area is a radiological control area. Only the contaminated groundwater present in the SRPA, outside of the current INTEC security fence, is addressed in the OU 3-13 ROD. The selected remedy is expected to fully address this contamination. However, this action does not address groundwater inside the current INTEC security fence, which will be addressed under OU 3-14.

- For the time period of 2095 and beyond, it is assumed that the SRPA located outside the current INTEC security fence will be used as a drinking water supply.

- The annual carcinogenic risk at INTEC from natural background radiation due to surface elevation and background soil radiological contamination is 10^{-4} (EPA 1994; NEA 1997; UNEP 1985).

- Permanent land use restrictions will be placed on those release site source areas and the INEEL CERCLA Disposal Facility complex, which will be closed in place, for as long as land use and access restrictions are required to be protective of human health and the environment.

To achieve a reasonable degree of protection at the WAG 3 sites, the Agencies have selected a remedy for each group of sites that meet the RAOs. These remedies protect human health and the environment and meet regulatory requirements. The WAG 3 RAOs were developed for specific media (i.e., soils, perched water, or groundwater). The applicable RAOs for a particular site or group of sites depend on the specific media impacted. The RAOs listed in Section 8 of the ROD, which are directly applicable to Group 4 include (Note: RAO numbering below is the same as in the ROD) the following:

1. Groundwater

    a. For INTEC-impacted groundwater (located in the groundwater contaminant plume outside of the current INTEC security fence), restore the aquifer for use by 2095 and beyond, so that the risk will not exceed a cumulative carcinogenic risk of 1×10^{-4} for groundwater ingestion

    b. For INTEC-impacted groundwater (located in the groundwater contaminant plume outside of the current INTEC security fence), restore the aquifer to drinking water quality (below MCLs) for use by 2095 and beyond

    c. For INTEC-impacted groundwater (located in the groundwater contaminant plume outside of the current INTEC security fence), restore the aquifer so that the noncarcinogenic risk will not exceed a total hazard index of 1 for groundwater ingestion.

2. Perched Water

    a. Prevent migration of radionuclides from perched water in concentrations that would cause SRPA groundwater outside the current INTEC security fence to exceed a cumulative carcinogenic risk of 1×10^{-4}, a total HI of 1; or applicable State of Idaho groundwater quality standards (i.e., MCLs) in 2095 and beyond

    b. Prevent excavations into and drilling through the contaminated earth materials remaining after the desaturation of the perched water to prevent exposure of the public to a cumulative carcinogenic risk of 1×10^{-4}, a total HI of 1; and protection of the SRPA to meet Objective 3a listed below.

3. Snake River Plain Aquifer (INTEC-derived groundwater contaminant plume outside current INTEC security fence)

    a. In 2095 and beyond, ensure that SRPA groundwater does not exceed a cumulative carcinogenic risk of 1×10^{-4}; a total HI of 1; or the applicable State of Idaho groundwater quality standards (i.e., MCLs).

3.3.2 Remediation Goals

To meet the RAOs, RGs are established. These goals are quantitative cleanup levels based primarily on risk to human health and the environment. The RGs are based on the results of the baseline risk assessment and evaluation of expected exposures and risks for selected alternatives. If an ARAR is more restrictive, then the ARAR standard is used as the RG. The RGs will be used to assess the effectiveness of the selected remedial actions in meeting the RAOs.

The RGs for INTEC-derived COCs in the SRPA groundwater outside the current INTEC security fence are based on the applicable State of Idaho groundwater quality standards (IDAPA 58.01.11.200). The SRPA COCs consist of tritium; Sr-90 and daughters, I-129, Np-237, chromium; and mercury prior to 2095, and Sr-90, I-129, Np-237, plutonium and uranium isotopes and their daughters, and mercury in 2095 and beyond. The SRPA groundwater RGs for these COCs are presented in Table 3-2.

The RG for INTEC-derived alpha-emitting radionuclides (Np-237, plutonium isotopes and their daughters, Am-241, and uranium isotopes and their daughters) in the SRPA groundwater outside the current INTEC security fence corresponds to a cumulative alpha-activity of 15 pCi/L in the year 2095 and beyond. WAG 3 RI/FS modeling has shown that alpha-emitting radionuclides are not expected to exceed the 15 pCi/L standard in the SRPA inside the current INTEC security fence until the year 2750, with a peak concentration occurring in the year 3804. Remediation, if necessary, of the tank farm inside the current INTEC security fence is expected to mitigate the future alpha-emitting radionuclide impacts in the SRPA outside the current INTEC security fence. Remediation goals for the alpha-emitting radionuclides in the SRPA inside the current INTEC security fence will be established in the final action developed in OU 3-14.

Table 3-2. SRPA contaminant of concern remediation goals.

Contaminant of Concern	SRPA Remediation Goals (Maximum Contaminant Levels) for Single COCs	Decay Type
Beta-gamma emitting radionuclides	Total of beta-gamma emitting radionuclides shall not exceed 4 mrem/yr effective dose equivalent	Beta-gamma
Sr-90 and daughters	8 pCi/L	Beta
Tritium	20,000 pCi/L	Beta
I-129	1 pCi/L as sole $\beta-\gamma$ emitter, all included to demonstrate compliance against 4mRem/yr	Beta-gamma
Alpha-emitting radionuclides	15 pCi/L total alpha emitting radionuclides	Alpha
Uranium and daughters	15 pCi/L—this includes all α emitters except as specified in 40 CFR 141.16	Alpha
Np-237 and daughters	15 pCi/L—this includes all α emitters except as specified in 40 CFR 141.16	Alpha
Plutonium and daughters	15 pCi/L—this includes all α emitters except as specified in 40 CFR 141.16	Alpha
Am-241 and daughters	15 pCi/L—this includes all α emitters except as specified in 40 CFR 141.16	Alpha
Nonradionuclides	—	—
Chromium	100 ug/L	Not applicable
Mercury	2 ug/L	Not applicable

The RG for beta-gamma-emitting radionuclides (tritium, Sr-90 and daughters, and I-129) in SRPA groundwater outside the current INTEC security fence is restricted to a cumulative dose of 4 mrem/yr in the year 2095 and beyond. The RGs for chromium and mercury are 100 ug/L and 2 ug/L, respectively, for individual constituent MCLs.

Additional performance-based remediation goals were established specifically for Group 4 in Section 8.1.4 of the ROD (DOE-ID 1999). The following are the perched water remediation goals:

- Reduce recharge to the perched zones
- Minimize migration of contaminants to the SRPA, so that the SRPA groundwater outside of the current INTEC security fence meets the applicable State of Idaho groundwater standards by 2095.

The perched water RGs are primarily designed to reduce the moisture content of the perched zone so that the contaminant transport rate in the vadose zone is reduced and radionuclide contaminants present in the perched zone have more time to naturally decay and reduce the concentration of potential contaminants released to the SRPA.

If the moisture content and contaminant flux are not sufficiently reduced as indicated by numerical modeling of the moisture content and perched water monitoring data, then additional infiltration recharge controls will be implemented to reduce moisture content and the contaminant transport rate in the perched zone.

3.3.3 Performance Measurement Points

The Group 4 remedial action performance will be evaluated against the Group 4 RAOs and RGs discussed above. Long-term monitoring points may be changed following 5 years of Phase II monitoring. The current long-term monitoring points are the Phase II monitoring points.

However, because the RAOs establish that the performance criteria will be met in the year 2095 and beyond, present-day measurement of whether or not RAOs are achieved is not possible. Numerical model predictions based on vadose zone moisture content and COC concentrations trends in both the vadose zone and aquifer beneath INTEC are required to determine whether the RAO will be met in 2095 and beyond. The monitoring program for vadose moisture content and COC concentrations in both the vadose zone and SRPA is established to support the numerical modeling (Note: SRPA monitoring beneath INTEC will be accomplished under the Group 5 monitoring program). Data obtained from the soil moisture monitoring and COC concentration sampling, as well as additional data regarding stratigraphy, lithology, and other new information, will be incorporated into the WAG 3 model to periodically update the model predictions for COC concentrations in 2095. Until the year 2095, this will be utilized to determine whether the RAOs are being met.

3.3.4 Rationale for Selection of Performance Measurement Points

Performance measurements for Group 4 are based directly on the RAOs, which are presented in the OU 3-13 ROD (DOE-ID 1999). The RAOs take land use assumptions into consideration and are protective of human health and the environment. The primary cause for establishing the performance measurement point at the security fence of INTEC in 2095 is the land use assumption stating that the SRPA outside of the INTEC security fence will be available for residential use in 2095. For this reason, water quality outside of the INTEC security fence in 2095 and beyond must meet drinking water standards.

3.4 Group 4 Perched Water ARARs

A complete listing of applicable ARARs, including an explanation of how they will be met on this project is provided in Section 4.2 of this document.

3.5 Technical Factors of Importance in Design and Construction

As described in the following sections, the technical factor of importance to the Group 4 remedial design is drilling through contaminated soil (or contaminated perched water) and flow in the BLR.

3.5.1 Drilling Through Soil or Perched Water Contamination

The construction of monitoring wells inside the INTEC security fence may involve drilling through zones of soil contamination and/or perched water contamination. Well construction design for these wells must account for the possibility of cross-contamination between zones, primarily in the form of carrying down contamination during drilling or creating a pathway for contaminant migration by constructing the well. Therefore, it is critical to seal any contaminated zone encountered (any soil or perched water that is discovered above the intended completion depth) from the borehole. This will generally be accomplished by grouting and casing the contaminated zone, reducing the drill bit size, and continuing drilling to the target depth. Several casing reductions may be required for the completion of a single well.

3.5.2 Flow in the Big Lost River

Successful completion of the Phase II geochemical study and BLR sampling events is contingent upon the flow in the BLR.

4. DESIGN BASIS

The bounding assumptions under which the Group 4 RD/RA activities will be performed include these assumptions that describe the limiting factors and conditions under which the RD/RA activities will be performed. These assumptions include the following:

1. Monitoring for each group will be performed as part of RD/RA and is separate from institutional controls.

2. A minimum institutional control period through the year 2095, for land-use or access restrictions required to be protective, will be implemented at all sites where contaminant concentrations exceeding allowable risk ranges are left in place. The continued need for land-use or access restrictions will be evaluated by the Agencies during each 5-year review.

3. Institutional Controls prior to 2095 will consist of site-access controls, radiological-posting controls, and land-use controls as shown in Table 11-1 of the ROD (DOE-ID 1999).

4. Groundwater contamination in the SRPA within the INTEC security fence will be addressed under OU 3-14.

5. The overall RAO for OU 3-13 is to achieve a HI of 1.0 or less and a cumulative increased carcinogenic risk of less than 1×10^{-4}.

In addition to the general assumptions listed above, the specific assumptions for Group 4, Perched Water, include the following:

1. Perched water is not a drinking water source and is unlikely to be sustainable once manmade sources of perched water recharge are eliminated.

2. Institutional controls will be protective in preventing exposure to contaminated perched water until 2095.

3. Deed restrictions and regulatory restrictions on drilling, construction, and placement of groundwater wells in the SRPA, which are drilled through contaminated perched water, will be implemented, to be effective beyond 2095.

4. Replacement percolation ponds will be operational by December 31, 2003. The new percolation ponds went into operation in August 2002.

5. Perched water monitoring equipment will be installed to monitor the drain-out of the perched water bodies expected after removal of the existing percolation ponds. Perched water monitoring equipment was installed in Phase I and additional monitoring equipment will be installed for Phase II.

6. The need for implementation of additional infiltration controls, such as lining the BLR will be determined based on data collected for the Phase II geochemical study, BLR sampling event, and analysis of water-levels after the existing percolation ponds are relocated. Because the Agencies have not performed the analyses required to modify the BLR channel per 40 CFR 230.10 (refer to Section 12 of the ROD [DOE-ID 1999]), lining of the BLR will require an explanation of significant differences to the ROD. Therefore, this activity is not included in this MSIP.

4.1 Discussion of Remedial Investigation/Baseline Risk Assessment Modeling

The OU 3-13 modeling scope included base-case predictions of flow and contaminant movement. In addition, the sensitivity of predicted contaminant migration to the parameters used to implement the conceptual model was obtained. Focus in the base-case simulations was on predicting groundwater concentrations in the year 2095 to support the 100-year risk scenario for the WAG 3 Comprehensive Baseline Risk Assessment. Simulations were performed for arsenic, chromium, mercury, Am-241, Co-60, Cs-137, H-3, I-129, Np-237, Sr-90, Tc-99, total plutonium, and total uranium originating either at the land surface (current soil inventory), or from historical waste process water discharge streams, accidental releases, and past use of the injection well. In addition, because the Test Reactor Area (TRA) facility is cross-gradient of INTEC, the two primary contaminants identified in the TRA remedial investigation (Cr and H-3) were included as aquifer source terms. However, predictions for the migration of TRA contaminants were not calibrated against field data.

In order to simulate contaminant transport from surface sources through the vadose zone, and eventually through the aquifer, two conceptual models were developed. The first of these two models was parameterized to simulate the infiltration of water and the subsequent transport of contaminants through the vadose zone. The vadose zone was conceptualized as being fully three-dimensional, with contaminants originating primarily at ground surface and infiltrating vertically as well as spreading laterally. Water and contaminant mass fluxes through the bottom layer of the vadose zone model were used as the upper boundary condition for the aquifer simulation domain. This second model (aquifer model) was also three-dimensional to account for contaminants being injected at depth from the injection well and for the mass fluxes originating at land surface. The vadose zone-aquifer contaminant system at INTEC was simulated using the three-dimensional multiphase transient code TETRAD. This code allowed incorporation of the heterogeneous physical properties necessary to solve the vadose zone infiltration problem with the large areal and point source influxes of water and contaminants. The numerical problem was broken into a vadose zone conceptual domain and an aquifer conceptual domain because of computational hardware limitations, although in theory, the two conceptual domains could have been included in a single numerical simulation.

The subsurface of INTEC has been extensively drilled and sampled, primarily by the USGS, in an effort to understand and monitor the movement of groundwater and contaminants beneath INTEC. In general, the subsurface at INTEC is typical of the INEEL as a whole and is part of a large volcanic plain of layered late Cenozoic basalt flows overlying a Rhyolitic basement. The geologic interpretation of INTEC indicates that the lithology (i.e., fracturing, vesicles, weathering surfaces) is not continuous between the 60 wells that have been drilled at INTEC. On the other hand, the larger-scale stratigraphic relationships between the basalt flows can be correlated horizontally between the wells. Typically, the correlation indicates that the sediment units are of variable thickness and differ in strike and dip angles. Permeability and porosity for the basalt, basalt fractures, and sedimentary interbeds differ by orders of magnitude as determined from field data.

From a hydrologic perspective, it is the change in vertical stratigraphy (and corresponding change in permeability and porosity) that controls the downward migration of water and contaminants into the vadose zone, the strike and dip of the sedimentary interbeds that allows subsurface lateral mixing of water sources to occur in the vadose zone, and the larger scale subhorizontal stratigraphic changes (and corresponding permeability and porosity) that have a primary influence on the direction of flow and depth of mixing of contaminants in the aquifer. As a result, the stratigraphy plays a primary role in the hydrologic description of INTEC. Therefore, the sedimentary interbeds in the vadose zone were represented using three-dimensional kriged valves for thickness and extent, as discussed in

Section 2.2.3.2 of Appendix F of the Remedial Investigation/Baseline Risk Assessment (RI/BRA) Report (DOE-ID 1997a).

The other primary hydrologic control at INTEC is presented by the numerous high-volume surface water recharge sources. There are eight broad categories of water sources distributed throughout the surface and shallow subsurface of INTEC. These include natural infiltration (558,960 kg/day), water system leaks (41,277 kg/day), landscape irrigation (13,500 kg/day), steam condensate (17,332 kg/day), the CPP-603 infiltration basins (511 kg/day), sewage treatment ponds (155,565 kg/day), service wastewater sent to the percolation ponds (5,838,868 kg/day), and the BLR (2,696,458 kg/day). Of these surface water sources, the service wastewater discharges and BLR are the primary contributors to infiltration and are located in the south and to the northwest of the INTEC facility, respectively. The complex stratigraphy, combined with the high-volume water sources, results in variably saturated flow in the vadose zone where regions of very low water saturation (approaching zero) are found in the basalt and where water saturations approach unity throughout many of the sedimentary interbeds. Within these sedimentary interbeds and interlayered basalts, water originating in the north mixes with water originating in the south. Flow in the subsurface of INTEC occurs in a subhorizontal direction as well as infiltrating vertically. This phenomenon explains why the vadose zone conceptual model was, of necessity, three-dimensional. Justification for the three-dimensional aquifer model is similar, and is based on both stratigraphic variability and vertical variability of the sources of contaminants entering the aquifer.

Fundamental parameters necessary to solve the vadose zone and aquifer water and contaminant transport problems include permeability relationships (saturated permeability for air and water, permeability-saturation curves, capillary pressure-saturation curves), porosity, dispersivity, and soil-contaminant partitioning relationships. These parameters need to be assigned for each different stratigraphic or lithologic unit incorporated by the conceptual model. In addition, the model requires boundary conditions in the form of either prescribed pressure or prescribed flux. A surficial summary is included below.

Vadose Zone Model. Hydraulic parameters for the transient vadose zone infiltration and transport model include saturated permeability for air and water, moisture characteristic relationships describing the constitutive relationships between capillary pressure-saturation and relative permeability-saturation, porosity, dispersivity, and parameters describing (in this specific case) matrix-contaminant adsorption. These parameters were assigned for the sedimentary units (alluvium and effective interbeds) and for the basalt fractures. Values for the basalt matrix were not assigned based on results of a previous modeling study conducted for the large scale infiltration test (LSIT) by Magnuson (1995). Reasons for neglecting the matrix contribution are given by Magnuson (1995) and are discussed in Appendix F of the RI/BRA (DOE-ID 1997a). Neglecting the contribution of the basalt matrix is based on simulations examining the relative contribution of basalt matrix (high porosity, low permeability) and basalt fractures (low porosity, high permeability) for a large field-scale infiltration test conducted at the INEEL. The simulation results indicated that the contribution of basalt matrix in the dual porosity formulation was negligible and that adequate matches to field data could be obtained considering only the basalt fractures and sediments in a single porosity formulation.

For this modeling, it was assumed that the basalt characteristics determined from the LSIT modeling (Magnuson 1995) were essentially appropriate for the INTEC basalts. Based on Magnuson's results, it was assumed that the basalts could be treated as an anisotropic "single porosity" media (that is, neglect the matrix and only simulate the fracture network), with a horizontal and vertical fracture permeability of 90,000 mD and 300 mD, respectively, and a basalt fracture effective porosity of 5%. Unsaturated moisture characteristic curves for the fractured material were discussed in Appendix F of the RI/BRA (DOE-ID 1997a). The sediment characteristics at INTEC were slightly different than those observed during the LSIT test, primarily because of the distribution and thickness of clay content. Thus, the sediment permeability was used as a calibration parameter, and results based in values ranging from 78 mD to 4 mD were obtained. Porosity for the sediments was also a calibration parameter.

The final parameter is based on tabulated constitutive parameters. Additional parameters used were (a) saturated water permeability of 4 mD (isotropic) in the sedimentary interbeds, (b) an isotropic alluvium permeability of 78 mD, (c) basalt fracture permeability of 90,000 mD horizontally and 300 mD vertically, and (d) sediment porosity of 48.7% and basalt fracture porosity of 5%.

Aquifer Model. Hydraulic parameters for the transient aquifer transport model include saturated permeability for water, porosity, dispersivity, and parameters describing (in this specific case) matrix-contaminant adsorption. There were four distinct stratigraphic types identified as playing a primary role in the transport of contaminants through the aquifer. These included an upper I basalt unit, a lower I basalt unit, the HI interbed, and the H basalt unit. Estimates of permeability for the I basalt region, wells local to INTEC, and regional estimates of hydraulic conductivity formed the database for aquifer hydraulic values. The I basalt unit was assigned permeabilities representative of those obtained in the INTEC pumping and injection wells. Larger-scale regional permeabilities were taken from the WAG 10 modeling effort (McCarthy et al. 1995). Local scale INTEC permeabilities are consistent with the INTEC well test results. Hydraulic parameters were assigned to the model grid based on the area in which the stratigraphic units appeared as discussed below.

The hydraulic conductivities used in the aquifer model were first interpolated onto the WAG 3 model grid from the final values determined from a WAG 10 regional groundwater flow model. The WAG 10 model used an Eastern Snake River Plain regional water balance to define the boundaries in order to ensure a water mass balance through the eastern SRPA. WAG 10 hydraulic conductivities ranged from 85,000 to 1,530,000 mD and were comparable in magnitude to the local INTEC values. Because of this similarity, the WAG 10 conductivities were believed to provide reasonable larger-scale values for long-term transport predictions for this INTEC model.

The upper I basalt unit, lower I basalt unit, and HI interbed are the dominant stratigraphic features in the saturated zone. The upper I basalt flow and lower I basalt flow differ hydraulically because the I basalt flow dips steeply near the north to northwest boundary of the INTEC model domain. This dip means that the top of the I basalt flow is probably more highly fractured and thus exhibits higher permeability, with the permeability decreasing in the flatter regions to the south. Distinguishing an upper and lower I basalt region was done by assigning a value representative of the CPP-01, CPP-02, and CPP-03 wells to the upper I basalt region, and assigning one-half of the lowest WAG 10, INTEC permeability (8.5E4 mD) to the lower I basalt region. These values replaced the WAG 10 permeabilities in grid blocks containing the I basalt flow. To be consistent with the sediment properties used in the vadose zone, permeability of 4 mD was assigned to the first layer of grid blocks overlying the I basalt flow. Assigning sediment properties uniformly over the I flow assumed that the HI interbed was 7.6 m thick and existed everywhere the I basalt flow exists. The final level of refinement for hydraulic conductivities in the INTEC aquifer model incorporated INTEC local scale field data. These local scale hydraulic conductivities above 90,000 mD were applied throughout the vertical profile defined by the footprint of the vadose zone model. The 90,000 mD cutoff limit was used based on observations made during the transport calibration phase.

4.1.1 Assumptions

The Comprehensive RI/FS for INTEC (DOE-ID 1997a) identifies several key assumptions used in the development of the modeling effort. The assumptions are described below:

- The basalt characteristics determined from the LSIT performed by S. O. Magnuson (1995) are also appropriate for the INTEC basalts. Based on Magnuson's results it was assumed in all simulations that the basalts can be treated as an anisotropic "single porosity" media. It was assumed that the material beneath INTEC will behave as did the material under the LSIT.

- In order to be consistent with Magnuson (1995), a horizontal and vertical fracture permeability of 90,000 mD and 300 mD, respectively, and an effective porosity of 5% has been applied to the vadose zone model. In addition, the presence of preferred flow channels is highly probable, as is the idea that they form the dominant transport paths in the basalts beneath INTEC.

- A steady-state contribution to infiltration has been assumed for the BLR.

- With the exception of the percolation pond areas, the precipitation contribution is assumed to be the largest areal mass flux.

4.1.2 Aquifer Modeling Results

The simulations of COC transport from their various sources through the vadose zone to the aquifer are summarized in Section 6 of the OU 3-13 RI/BRA (DOE-ID 1997a). By the year 2025, the chemical concentrations of chromium and total uranium will be below their HQ=1 based concentration and the Co-60 concentration will be below its 10^{-6} risk-based concentration. By the year 2095, the concentrations of H-3, total plutonium, and Tc-99 will be below their 10^{-6} based concentrations. Chromium, Co-60, H-3, and Tc-99 concentrations will all continue to decrease in the future. Total uranium and total plutonium concentrations will increase in the future. Of the remaining COCs, the aquifer concentrations of Cs-137, I-129, mercury, Np-237, and Am-241 will all decrease after 2095 and the concentrations of arsenic and Sr-90 will increase. After the year 2095, the arsenic increase is predicted to be minor but the total plutonium (factor of 250), Sr-90 (factor of 2), and total uranium (factor of 10) increases are predicted to be significant.

Institutional controls have been assumed to be in place until the year 2095. Of particular interest are the peak groundwater concentrations after the institutional control period. These peak concentrations and the timing of the peaks are shown in Table 6-8 of the RI/BRA (DOE-ID 1997a). In the year 2095, peak concentrations in the aquifer are predicted to be decreasing for chromium, Co-60, Cs-137, H-3, I-129, mercury, Np-237, Tc-99, and Am-241. However, aquifer peak concentrations are predicted to rise after the year 2095 for Sr-90 (until year 2172), uranium (until year 2468), arsenic (until year 4279), and plutonium (until year 3585).

4.2 Evaluation of Compliance with Applicable or Relevant and Appropriate Requirements

Table 4-1 contains a list of the ARARs identified in the ROD for the work to be conducted under this MSIP for Group 4. These ARARs were identified as action-specific, chemical-specific, and to be considered (TBC); no location-specific ARARs were identified. Table 4-1 lists the ARARs, as well as the specific action that will be taken to ensure the ARARs are met.

4.3 Plans for Minimizing Environmental and Public Impacts

One of the general purposes of the FFA/CO is to "expedite the cleanup process to the maximum extent practicable consistent with protection of human health and the environment" (DOE-ID 1991). The parties to the FFA/CO intended that any response action selected, implemented, and completed under the Agreement will be protective of human health and the environment such that remediation of releases covered by the Agreement shall obviate the need for further response action.

The planning for this project has utilized well-established and available processes and guidance, to achieve compliance with CERCLA and RCRA processes. Special consideration will be given to the disposition of dangerous materials or emergency conditions. To assess and to determine potential impacts from storm water, a Storm Water Prevention Plan was prepared and is presented in Appendix I.

Table 4-1. Compliance with ARARs for Group 4, Perched Water, selected remedy.

Alternative/ARARs citation	Description	Applicable, or Relevant and Appropriate (R&A), or TBC	Comments
Group 4—Perched Water: Alternative 2—Institutional Controls with Aquifer Recharge Control			
Action-specific			
IDAPA 16.01.05.008 (40 CFR 264.14)	Site security	Applicable	The project site is located within the INEEL, which has restricted access.
40 CFR 230.10 and 11	Substantive requirements of 40 CFR 230.404 specifications of disposal sites for dredged or fill material	Applicable	This project will not modify the BLR channel.
Executive Order 11990	Protection of wetlands	Applicable	This project will not affect any wetlands.
Executive Order 11988	Floodplain management	Applicable	This project will not modify the BLR channel.
Rivers and Harbors Act	Section 10 of the Rivers and Harbors Act of 3 March 1899	Applicable	This project will not modify the BLR channel.
IDAPA 37.03.09	Idaho well construction standards	R&A	Wells will be constructed according to the requirements of the IDAPA 37.03.09.
IDAPA 16.01.05.008 (40 CFR 264.114)	Disposal or decontamination of equipment, structures, and soils	Applicable	Equipment will be decontaminated and screened prior to release. Wastes will be managed in accordance with the Waste Management Plan. No structures will be affected by this project.
IDAPA 16.01.01.650, 16.01.01.651	Idaho fugitive dust emissions	Applicable	Dust suppression measure will be implemented as necessary during the drilling and sampling events to minimize the generation of fugitive dust and restrict the potential spread of contamination. These measures may include water sprays, minimizing vehicle speeds, and work controls during periods of high winds.

Table 4-1. (continued).

Alternative/ARARs citation	Description	Applicable, or Relevant and Appropriate (R&A), or TBC	Comments
IDAPA 16.01.01.585, 16.01.01.586	Rules for the control of air pollution in Idaho	Applicable	It is not anticipated that this project will generate any air emissions of significance.
40 CFR 61.92, 61.93	NESHAPS for radionuclides from DOE facilities, emission monitoring and emission compliance	Applicable	If radioactive contamination is encountered, analytical data will be collected to quantify the amount of activity released. Appropriate actions will be taken to ensure compliance.
IDAPA 37.03.07.030	Idaho stream channel alteration rules	Applicable	This project is not expected to impact the BLR.
IDAPA 16.01.05.008 (40 CFR 264.533)	Temporary units	Applicable	Temporary units are not expected to be needed. Wastes should be managed at the ICDF. If temporary units are necessary, wastes will be stored in the appropriate containers.
IDAPA 16.01.05.008 (40 CFR 264.554)	Remediation waste staging piles	Applicable	Remediation waste staging piles may be required for short-term management of the waste pending waste characterization, ICDF acceptance of the profile, and subsequent transfer to that facility
Chemical-specific			
IDAPA 16.01.05.006 (40 CFR 262.11)	Hazardous waste determination	Applicable	Waste generated as a result of remediation will be handled according to the project-specific Waste Management Plan.
10 CFR 20 Appendix B, Table 2	Annual limits for radionuclides effluent concentrations	R&A	This project will not place any material into the BLR.

Table 4-1. (continued).

Alternative/ARARs citation	Description	Applicable, or Relevant and Appropriate (R&A), or TBC	Comments
Location-specific			
None identified			
TBCs			
DOE Order 435.1	Radioactive waste management performance objectives to protect workers	TBC	In addition to the project-specific HASP (Appendix H), a Job Safety Analysis, and/or radiological permit(s) will be prepared for the tasks where there is potential for exposure to radioactive contamination/materials, to protect human health, and the environment. Radiological work permits will only be used as determined by the radiological controls technician, based on company policies and procedures. Radioactive waste generated during the project will be managed according to the project-specific Waste Management Plan.
DOE Order 5400.5	Exposures to the public will be kept as low as reasonably achievable	TBC	In addition to the project-specific HASP and/or radiological permit(s) will be prepared for the tasks where there is potential for exposure to radioactive contamination/materials, to protect human health and the environment. Radiological work permits will only be used as determined by the radiological controls technician, based on company manuals. Radioactive waste generated during the project will be managed according to the project-specific Waste Management Plan.

5. REMEDIAL DESIGN

This section outlines the activities that will be performed to meet the RAOs and RGs set forth in the ROD.

5.1 Phase I Well Installation and Sampling

Twenty-one new wells were drilled between November 16, 2000, and March 30, 2001, as part of the Phase I drilling and well installation. The wells were constructed and outfitted with instrumentation to collect data required by the OU 3-13, ROD and as specified in the FSP (Appendix B). Moreover, these wells were constructed specifically to provide subsurface data to evaluate the hydrologic connection between recharge sources surrounding INTEC and the perched water observed beneath it. Further details about the Phase I well installations and sampling is provided in the *Phase I Monitoring Well and Tracer Study Report for OU 3-13, Group 4, Perched Water* (DOE-ID 2003).

5.2 Phase I Tracer Study

A tracer study was conducted during Phase I in accordance with the Tracer Test Plan found Appendix D. The results of the study are described in *Phase I Monitoring Well and Tracer Study Report for OU 3-13, Group 4, Perched Water* (DOE-ID 2003).

5.3 Phase II Activities

Activities to be included during Phase II includes (a) routine sampling and analysis, (b) additional well monitoring instrumentation, (c) geochemistry sampling and analysis, and (d) an INTEC water balance engineering study. Additional monitoring wells may be installed as part of the Phase II activities. If required by the WCF permit, any new wells drilled for WCF monitoring will also be used for Group 4 monitoring. A description of each of these activities is provided below.

5.3.1 Routine sampling and Phase II Monitoring Wells

The Phase II activities include the routine sampling and analysis for the OU 3-13, Group 4, Perched Water. Perched water wells will be sampled annually. Analytes include the COCs (tritium, technetium-99, iodine-129, strontium-90, plutonium isotopes (Pu-238, -239, -240, -241, and -242), uranium isotopes (U-234, U-235, and U-238), neptunium-237, americium-241, cesium-137, and mercury) along with TAL metals (calcium, magnesium, sodium, potassium, strontium, antimony, arsenic, beryllium, cadmium, chromium, lead, silver, thallium plus boron, and strontium). Samples will be analyzed for anions (sulfate, chloride, bromide, fluoride, nitrate, nitrite, and phosphate). Samples will be analyzed for the COCs listed above annually during Phase II and all other analytes listed above biannually (every second year).

The Phase II wells may be installed to provide moisture monitoring and COC sampling locations for monitoring the perched water drain-out and contaminant flux to the SRPA. All well sets will contain at least three wells, one to be completed in the upper perched water zone (Figure 5-1), another to be completed in the lower perched water zone (Figure 5-2), and a third to be completed in the SRPA (Figure 5-3).

If installed, the aquifer skimmer well will be screened across the water table so that the screen will be set slightly below the SRPA water table (~140 m [460 ft]). The SRPA skimmer well will be used for sampling SRPA water to determine contaminant flux originating in the vadose zone. Placement of these wells will be primarily around the tank farm; however, placement and need for the Phase II wells will be based on the results of the geochemical study and engineering study.

If installed, Phase II perched water wells will be instrumented similar to the Phase I wells and will include tensiometers (to measure soil tension), suction lysimeters (for collecting pore-water samples), and piezometers. Piezometers will be placed if significant perched water is encountered to allow for water level measurements and sampling. Each Phase II well that has sufficient water will also be equipped with a pressure transducer to measure water levels. The suction lysimeters and tensiometers will be installed in the primary perching zones. Lysimeter and tensiometer placement in the perched water zones will allow for continued contaminant sampling as the saturation level decreases as well as for the collection of moisture measurements.

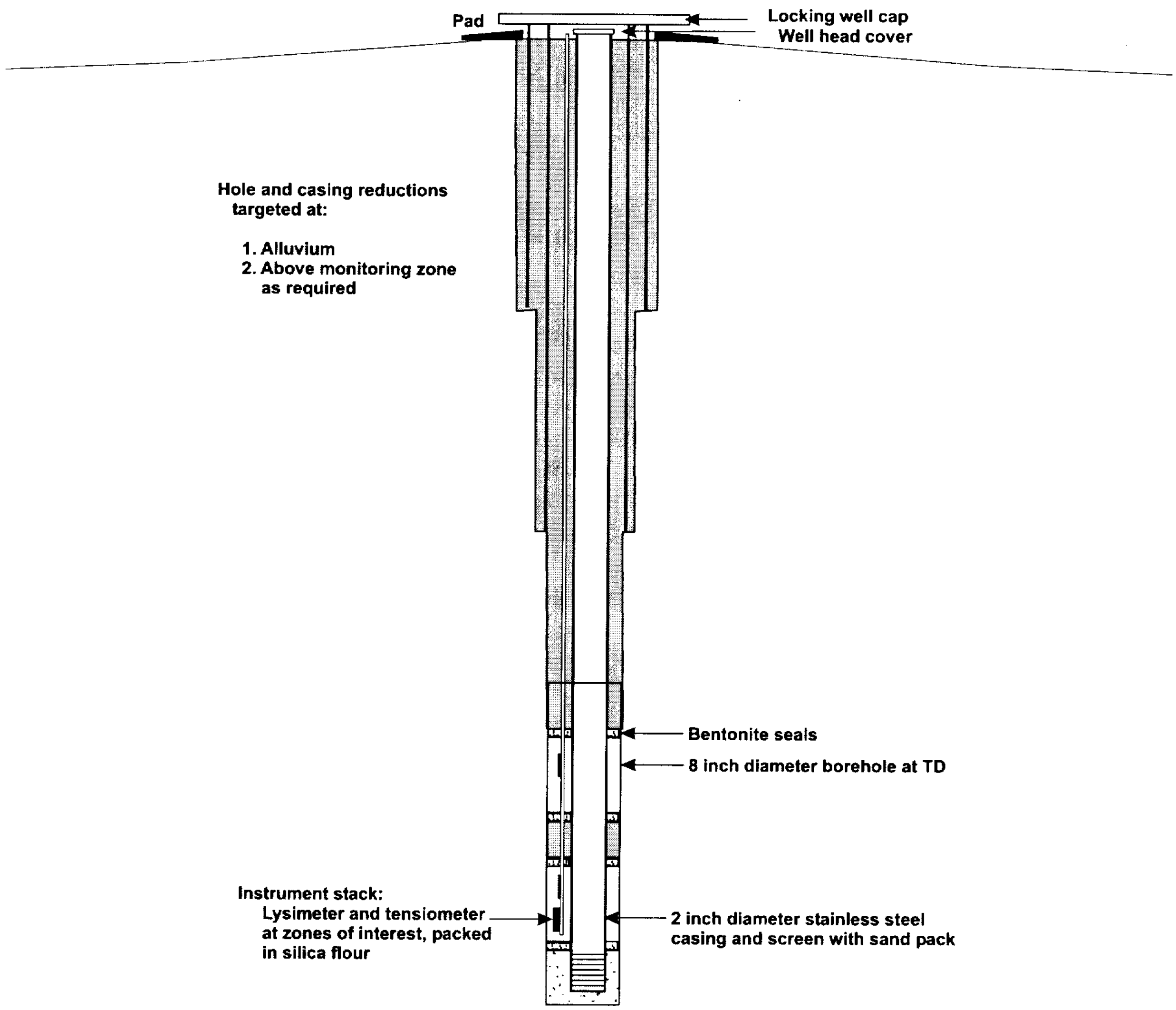

Figure 5-1. Conceptual diagram for upper perched water zone instrument installation.

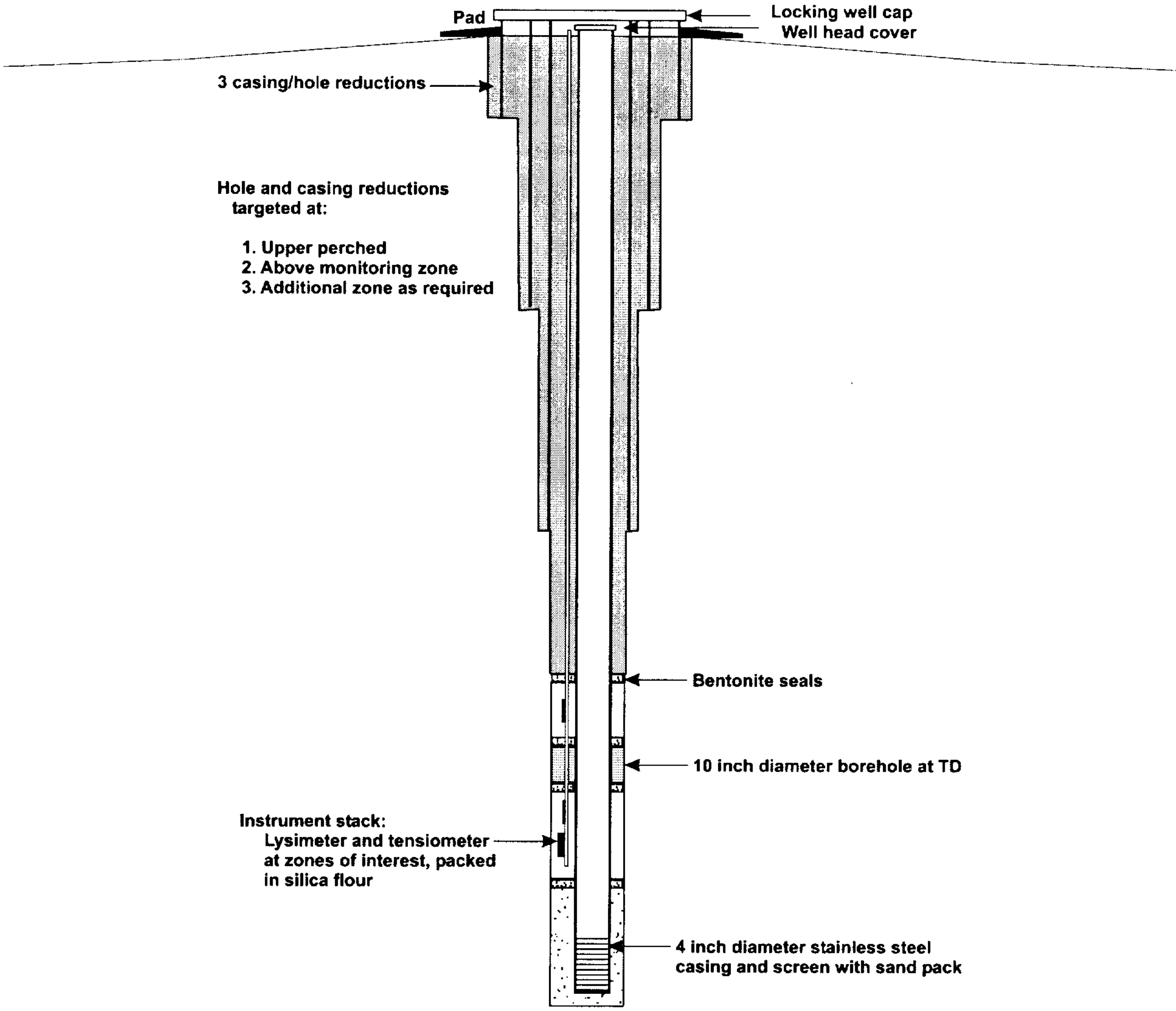

Figure 5-2. Conceptual diagram for lower perched water zone instrument installation.

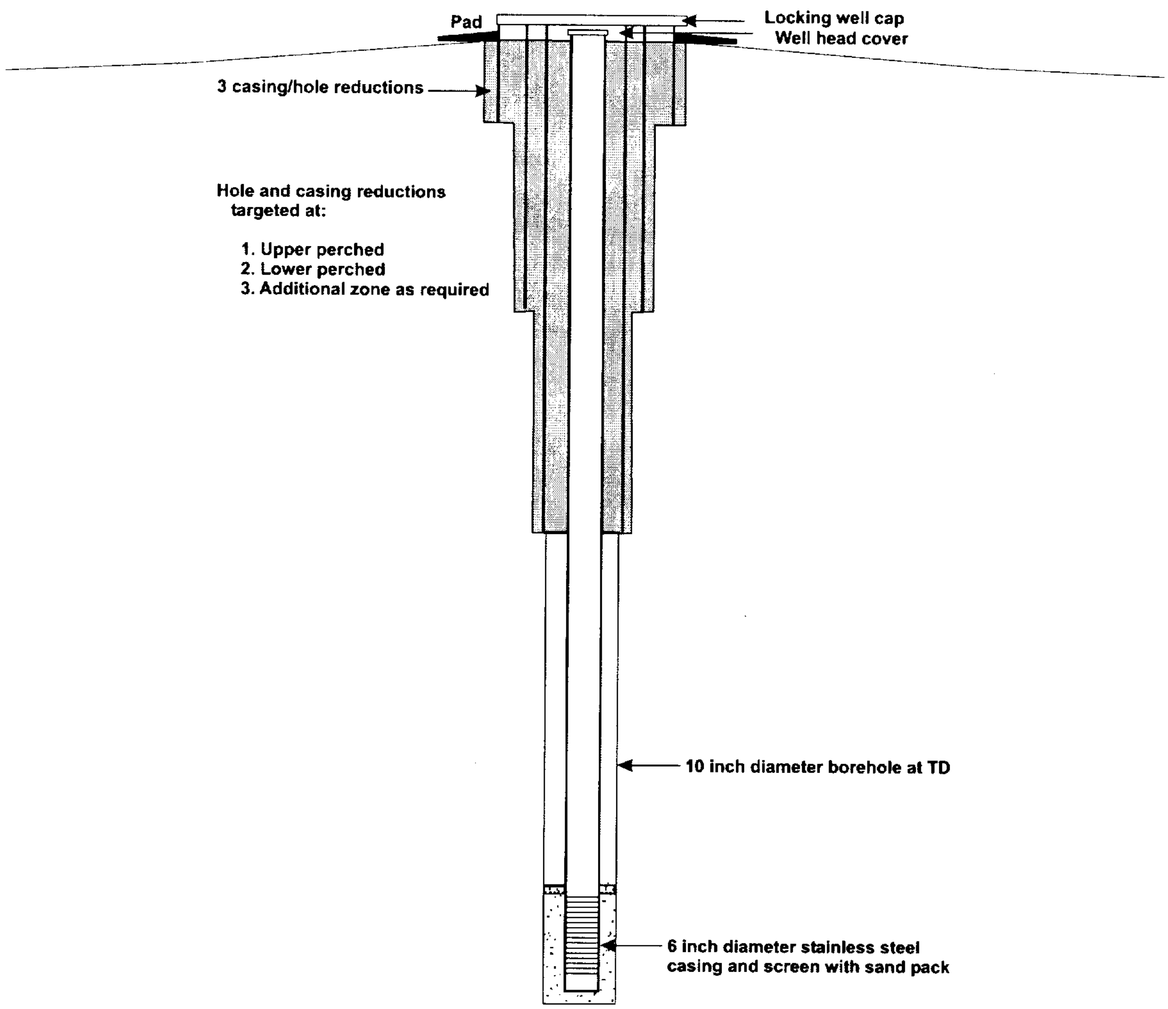

Figure 5-3. Conceptual diagram for aquifer well completion.

5.3.2 Drawings and Specifications

This section outlines the specifications for the information that will be collected to make a decision on the need to implement the BLR contingency. Drawings for the Phase II wells are provided (Figures 5-1, 5-2, and 5-3), but they are subject to change to meet future needs.

5.3.2.1 Specifications. This subsection presents methods and materials that will be used in the successful completion of Phase II work. The deepest hole in each well set will be drilled first with continuous core collection from ground surface to total depth. Coring operations will start with a PQ-size, wire-line core barrel. As perched zones are encountered, they will be cased off and the core barrel size reduced accordingly to prevent contaminant movement to lower, possibly cleaner, perched zones, as the borehole is being advanced. Additional details on Phase II drilling and sampling can be found in the *Field Sampling Plan for Operable Unit 3-13, Group 4 Perched Water Well Installation* (Appendix B).

Phase II well details are provided in Table 5-1. Projected well depth, instrumentation and hole size are also shown.

Table 5-1. Potential Phase II well installation details.

Well Type	Projected Depth	Approximate Borehole Size	Proposed Instrumentation
Shallow perched	120 to 140 ft bgs	6 to 12 in.	2 lysimeters 2 tensiometers 1 moisture sensors 2-in. piezometer
Deep perched	380 to 400 ft bgs	6 to 12 in.	2 lysimeters 2 tensiometers 1 moisture sensors 4-in. piezometer
Aquifer skimmer	450 to 475 ft bgs	10 to 12 in.	6-in. monitoring well-screened across water table

Upon reaching the target depth, each borehole will be geophysically logged. At a minimum, logging will consist of video, caliper, natural gamma, deviation, gamma-gamma, neutron, density, and high-resolution gamma spectroscopy. All geophysical logs will be used for comparison of information and to assist in the determination of instrument placement. Well data logging will be performed by the USGS's INEEL field office and BBWI personnel.

Upon completion of down-hole logging, the open boreholes will be equipped with instrumentation to provide for long-term monitoring of vadose zone moisture and the collection of pore water samples. Results of the well logging will be used to determine the exact placement of the instrumentation. It is anticipated that each borehole will be equipped with two tensiometers, two suction lysimeters, and a moisture sensor. In addition, one aquifer skimmer well will be installed as part of the well set. Tensiometers will be placed such that one is located below the interbed and one is at the top of the interbed. Suction lysimeters will be installed in a similar manner to the tensiometers. They will be placed such that the porous ceramic sample cup is located at approximately the top of the interbed. All upper and lower wells may also have piezometers (2-in. for upper, 4-in. for lower) installed if free water is encountered.

The aquifer wells will be constructed with a minimum of 6-in., 304 stainless steel, 40-slot screen and Schedule 5 casing. A dedicated submersible pump with a stainless steel discharge line will be installed. After reaching the target depth and upon completion of geophysical logging (in the deep borehole), the screen and casing will be lowered into the open borehole. For aquifer wells, it is anticipated that 7.6 m (25 ft) of screen with a 1.5-m (5-ft) sump will be used. The screened interval will extend 1.5 m (5 ft) above the static water table. The bottom of the screen will extend across the first fractured interval. The exact screen length will be determined in the field. After placing the screen/casing assembly, the annular space around the screen will be filled with clean silica sand as a filter pack. Sand will extend to approximately 5 ft above the top of the screen. A 1.5-m (5-ft) granular bentonite plug will be placed on the filter pack and hydrated. After full hydration of the bentonite the remaining annulus will be filled with a nonshrink cement grout.

For perched zones where sufficient perched water is encountered, piezometers will be installed. The screen bottom will be placed as close as practical to the top of the interbed. A dedicated submersible pump may be installed, also with a stainless steel discharge line. Motor size of the submersible pump will be determined based on the depth to water.

Wells will be developed after completion; however, the criteria and method for development will be determined in the field based on the available water in each well. It is anticipated that some wells will have only a couple of inches of water so that full well development cannot be performed. Details on well development can be found in Appendix B.

Existing perched zone wells will receive instrumentation consistent with their intended use. At a minimum, this will include pressure transducers in all existing perched wells that have water. Other equipment that may be installed includes dedicated pumps and tensiometers. Tensiometers may be installed by backfilling the screened interval with silica flour.

5.3.2.2 Proposed Well Locations. Locations for the Phase II wells, if needed, will be determined after the geochemical and engineering/water balance studies.

5.3.2.3 Well Instrumentation Diagrams. Figure 5-3 shows the typical aquifer well installation. Figure 5-1 and Figure 5-2 show the typical perched zone instrument installation.

5.3.3 Well Instrumentation

Sixteen wells in the northern part of INTEC are planned to be instrumented with temperature, conductivity, and water-level probes. The locations are shown on a map in Appendix N. The conductivity data will be used to evaluate the influence of the BLR on the perched water in the northern part of INTEC by examining the change in conductivity of the wells versus changes in water-level. The BLR has an average specific conductance of 340 μmhos/cm and a range of 250 to 420 μmhos/cm for the period from 1984 to 1998 (USGS 2002) while the perched wells in the northern part of INTEC have conductivity values in the 800 μmhos/cm range. The USGS monitors the flow and conductivity of the BLR at the Lincoln Blvd Bridge.

Wells in the northern part of INTEC that are planned to be instrumented with probes to measure water-level, conductivity, and temperature to evaluate impacts from the BLR, will include TF-AL, TF-DP, TF-CH, BLR-AL, BLR-SP, BLR-DP, BLR-CH, 33-2, 33-3, 33-4, 37-4, MW-24, MW-1-4, MW-10-2, MW-5, and MW-2. The ability to instrument these wells assumes that the water-level, conductivity, and temperature probe will fit down these wells.

5.3.4 Geochemistry Sampling

The geochemical evaluation of potential recharge sources will consist of two studies: (1) a nitrogen and oxygen isotopes study and (2) a geochemical study of recharge sources that will focus on identifying the sources of perched water in the northern part of INTEC near the tank farm. The nitrogen isotope and geochemical studies are described in detail with figures showing the sampling locations in Appendix N.

5.3.4.1 Nitrogen Isotope Study. The goals of the nitrogen isotope study are (1) to identify the contributions of the sewage treatment plant and tank farm to shallow and deep perched wells in the northern part of INTEC and (2) identify the source of elevated nitrate concentrations in the SRPA downgradient of INTEC. Potential nitrate sources include the sewage treatment lagoons and industrial source(s) such as the tank farm. To accomplish the goals of the nitrogen isotope study, both perched water and aquifer wells have been selected for sampling and the $\delta^{18}O$ of nitrate will also be determined.

A preliminary sampling event for nitrogen and oxygen isotopic ratios in nitrate will occur during the first sampling event for the geochemical study. This data will be collected while the sewage treatment lagoons are still in operation and includes wells MW-24, 37-4, 55-06, MW-2, MW-5, MW-1-4, and USGS-50. An extended sampling event for nitrogen and oxygen isotope ratios in nitrate for perched wells 55-06, MW-5, MW-2, MW-20-2, MW-10-2, 37-4, MW-4, MW-24, MW-1-4, USGS-50, STL-DP, CS-CH, 33-2, 33-3, and 33-4 will be conducted during the annual Groups 4 and 5 sampling events to evaluate the sources of elevated nitrate concentrations in the shallow and deep perched water wells in the northern part of INTEC and influence on the SRPA (Figure 5-4). Groundwater samples will be collected from SRPA wells USGS-121, USGS-47, USGS-112, USGS-77, USGS-123, USGS-52, and ICPP-MON-A-230 to evaluate potential impacts on the SRPA from perched water and contaminant flux from the tank farm area or the sewage treatment lagoons.

5.3.4.2 Geochemical Study. The goal of the geochemical study is to characterize the various water sources (sewage lagoons, drinking water supply, snow, water supply, steam discharge, precipitation, BLR, and fire water/raw water) in terms of major cation and anion chemistry, and oxygen and hydrogen isotope characteristics to identify their contribution to the perched water near the tank farm. The chemical signatures of the various water sources will be used to determine their impact on the perched water. The geochemical study is an approximately 1-year sampling program designed to monitor the influence from various potential sources of perched water. Samples from the potential water sources will be analyzed for major cation and anions and for oxygen and hydrogen isotopic composition as listed in Table 5-2. The details of the geochemical sampling study along with a sampling schedule is included in the FSP in Appendix N.

If the BLR flows and if water-levels rise in the perched wells near the tank farm in 2004, a geochemical study sampling event and a BLR sampling event will be combined to characterize the influence from the BLR on perched water chemistry and will analyze for anions, metals/cations (filtered), tritium, and strontium-90. Samples for metals/cations will be filtered so that the data are comparable. These data, in combination with water-level and conductivity data, will be used to evaluate the impact of the BLR on perched wells in the northern part of INTEC.

5.3.5 INTEC Water Balance Engineering Study

An INTEC facility water balance/engineering study will be conducted to assess potential sources of perched water recharge from facility operations and practices. The engineering study will focus on (a) summarizing historical reports, data, and research pertaining to INTEC water budgets and determine current applicability, (b) identifying and quantifying existing facility operations and/or infrastructure that may serve as vadose zone recharge sources, (c) making recommendations for monitoring, metering, or quantifying the recharge sources, and (d) suggesting methods to minimize recharge to perched water bodies to prevent the transport of contaminants below INTEC into the aquifer.

The intent of the engineering study will be to identify and quantify, to the extent possible, the facility sources that contribute to perched water recharge under INTEC. The scope will include calculating a water inventory and balance using historical data from existing monitoring equipment at the INTEC facility. The study will focus on facility systems and practices such as water systems, steam systems, and sewer and waste systems. Possible recharge sources that will be investigated during this study include the following:

- Fire water systems
- Raw water systems
- Potable water systems

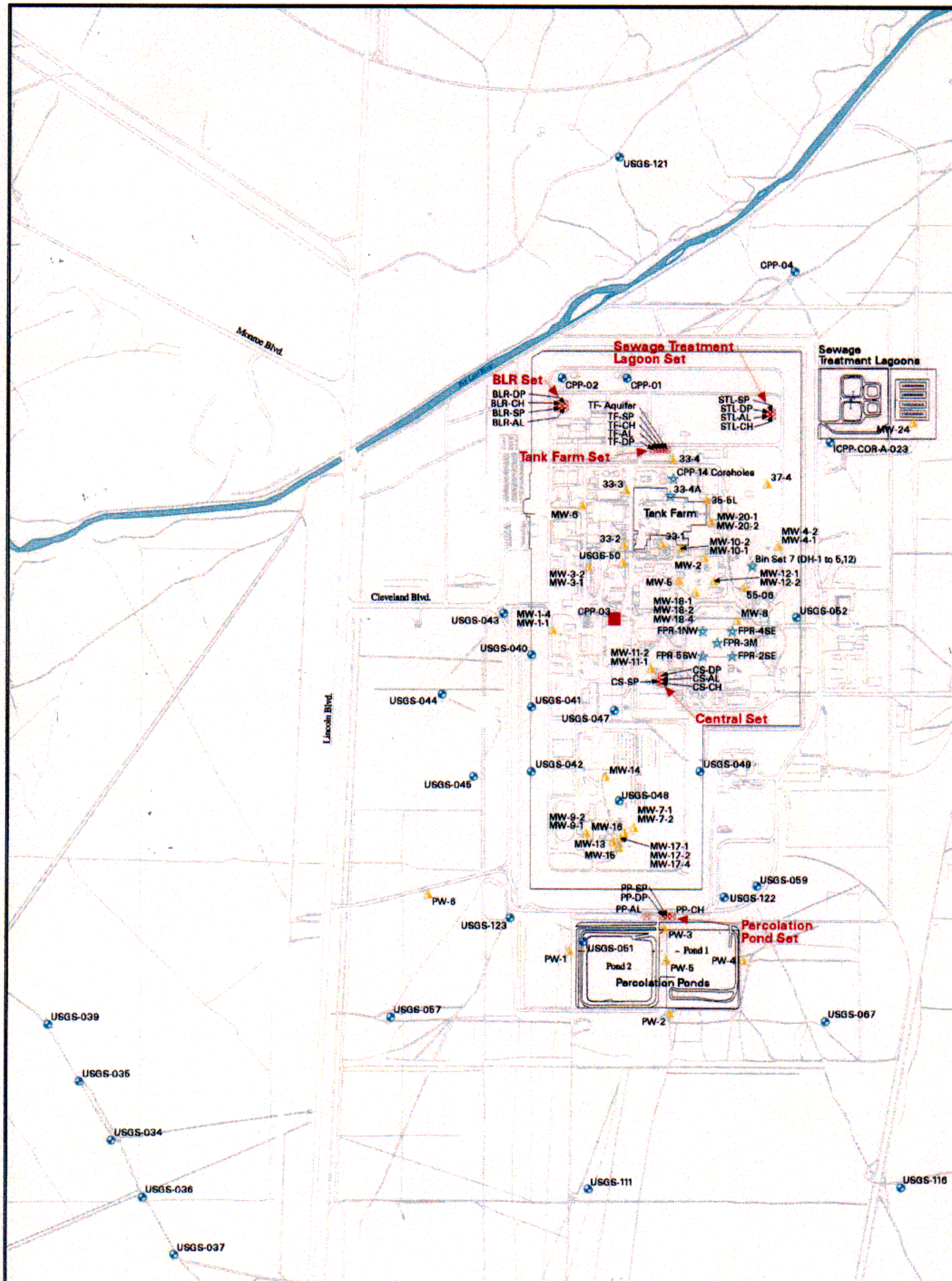

Figure 5-4. INTEC area map showing locations of sampling stations.

Table 5-2. Phase II chemical and geotechnical data collection.

Cations	Anions	COCs	Field	Other	Geotechnical	Geophysical
Calcium	Sulfate	Tritium	Temperature	Nitrogen isotope ratio	Bulk density	Video
Magnesium	Chloride	Technetium-99	pH		Grain size	Caliper
Sodium	Bromide	Iodine-129		Oxygen isotope ratio	Porosity	Natural gamma
Potassium	Fluoride	Strontium-90	Dissolved oxygen		Moisture content	Deviation
	Nitrate	Plutonium isotopes (Pu-238, -239, -240, -241)	Specific conductivity		Moisture characterization curve	High resolution gamma spectroscopy
Antimony				Alkalinity		
Arsenic						
Boron		Uranium isotopes (U-234, -235, and -238)		Hydrogen isotope ratio	Saturated and unsaturated hydraulic conductivity	
Beryllium						
Cadmium						
Chromium		Am-241			Permeability	Gamma-gamma
Lead		Np-237			Field capacity	Density
Silver		Cs-137				Neutron
Thallium		Mercury				

- Demineralized water systems
- Steam condensate systems
- Sanitary sewer systems
- Service waste systems
- Landscaping systems
- Drains, basins, sewers, and other outlets
- Water infiltration and pooling areas
- Tank farm vault sump inputs and outputs
- Other infrastructure systems or practices, as identified.

A report will be prepared that summarizes previous studies, the infrastructure checked and/or currently monitored for leaks, conclusions, and recommendations for reducing discharges to perched water bodies and improvements to the monitoring of the discharge rates.

5.3.6 Waste Calcining Facility Postclosure Monitoring

The purpose of the WCF postclosure monitoring is to meet the HWMA/RCRA groundwater monitoring requirements for this closed facility. An HWMA/RCRA postclosure permit will be issued for the former WCF in the late summer or fall of 2003. Because monitoring of this facility will utilize several of the same monitoring wells as Group 4 and the data generated will support the Group 4 decision, the field activities associated with the WCF postclosure monitoring program will be integrated with the CERCLA Group 4 program in order to achieve efficiencies and cost savings in the areas of planning, sample collection, and waste management. Waste generated by the WCF monitoring program will be managed under the Group 4, Waste Management Plan (Appendix F).

6. REMEDIAL ACTION WORK PLAN

The OU 3-13 RD/RA SOW (DOE-ID 2000) identifies that the scope for Group 4 consists of the installation of 10 new vadose zone wells and the monitoring of an unspecified number of existing wells. In addition, reference is made that six "cluster" wells may be installed around the INTEC tank farm. Each set of "cluster" wells consisted of four different completion depths. The total number of wells under consideration was 34, which includes 10 wells to better understand moisture movement and an optional 24 wells around the tank farm. Through an evaluation of the available data and the DQO process, a decision was made that a total of 21 wells in Phase I, and if deemed necessary an additional six wells in Phase II, would be installed to meet the objectives of the OU 3-13 ROD (DOE-ID 1999). The work scope includes the long-term monitoring of the new and existing wells in order to evaluate the drain-out of the perched water zones beneath INTEC.

If the planned removal of the percolation ponds does not result in adequate drain-out of the perched water zones, additional recharge control measures will be evaluated and implemented. Recharge controls under consideration at this time include (1) lining the BLR, (2) upgrading the INTEC-wide drainage controls, repairing leaking fire water lines, and eliminating steam condensate discharges, and (3) closing and relocating the existing Sewage Treatment Plant lagoons and infiltration galleries.

6.1 Subcontracting Plan

The Phase II work elements comprising this remedial action consist primarily of sampling and analysis of the existing wells and possibly the installation of additional monitoring wells.

The drilling and well installation are planned to be competitively bid for and awarded to the lowest qualified bidder on the basis of cost (per lineal foot of drilling). BBWI's procurement process will be followed and will include, but is not limited to, issuance of a Request for Proposal, prebid conference, bid evaluation, notice of award, notice to proceed, vendor data submittals, and preconstruction kick-off meeting.

Other work elements described in this MSIP may be performed under a single subcontract or several subcontracts. Site force personnel may perform a portion of this work, if necessary. Both subcontract and site personnel will be required to perform to the schedule detailed in Appendix L of this document in order to meet the overall project schedule and objectives.

Task elements expected to be subcontracted include the following:

- Well drilling/completion
- Laboratory analysis.

6.2 Remedial Action Work Elements

This section provides an overview of the general method by which the major elements of the Remedial Action Work Plan will be accomplished. Each drilling phase will be a separate contract (possible with different subcontractors). For this reason, there will be duplication of premobilization, mobilization, and demobilization phases associated with drilling activities discussed below.

6.2.1 Premobilization

Premobilization efforts involve all work elements that must be completed before the drilling contractor arrives on the site to start work. This includes such work as securing a contract for drilling services, surveying proposed locations, marking proposed locations for underground utilities, approval of a work control package, and approval of vendor data submittals. The final premobilization effort is a formal prejob meeting at which the SOW is discussed and HASP training is conducted. Any outstanding questions about the work to be performed are resolved at this meeting.

6.2.2 Mobilization

After the prejob meeting, the drilling contractor will be free to begin mobilization of their equipment to the site. Mobilization of equipment consists of physically locating all drilling and ancillary equipment at the site and setting up on the first hole to be drilled. This will include an inspection and acceptance of the drilling equipment mobilized to the site by the field team leader, or designee.

6.2.3 Phase I Well Installation

The Phase I well installation is described in *Phase I Monitoring Well and Tracer Study Report for OU 3-13, Group 4, Perched Water* (DOE-ID 2003).

6.2.4 Baseline Sampling

The baseline sampling results are described in *Phase I Monitoring Well and Tracer Study Report for OU 3-13, Group 4, Perched Water* (DOE-ID 2003).

6.2.5 Tracer Study

The Phase I tracer study results are described in *Phase I Monitoring Well and Tracer Study Report for OU 3-13, Group 4, Perched Water* (DOE-ID 2003).

6.2.6 Phase II Well Installation

Phase II well installation, if needed, will be performed in a manner similar to Phase I. Installation of the Phase II wells will be under a competitively bid and awarded the subcontract. Drilling of the new wells will be performed in accordance with the contract established with the drilling subcontractor during premobilization actions. A trained geologist, supported by the area construction engineer, will observe the well drilling activities to log the borehole and well construction and ensure that the final completion meets the contract requirements. INEEL personnel will perform sample collection activities associated with the drilling. Borehole geophysical logging will be performed by the USGS.

6.2.7 Long-Term/Monitoring of Phase I and II Wells

The 21 Phase I wells and 40 existing INTEC vadose zone and aquifer wells will be sampled and monitored on an annual basis for 5 years following the relocation of the percolation ponds. Phase II wells will also be sampled if they are installed. Sampling activities will be performed in a manner similar to baseline sampling discussed above.

6.2.8 Well Instrumentation

Sixteen wells in the northern part of INTEC are planned to be instrumented with temperature, conductivity, and water-level probes to evaluate the impact of the BLR.

6.2.9 Engineering Study of INTEC Facility Infrastructure and Practices

An engineering study will be conducted to identify the facility operations and discharge practices that may contribute to perched water recharge at the INTEC facility. Based on the results from the engineering study, a second phase of controlling or monitoring of water discharges at the facility may be implemented.

6.2.10 Geochemical Evaluation

The geochemical evaluation of potential recharge sources will consist of two studies: (1) a nitrogen and oxygen isotopes study and (2) a geochemical study of recharge sources that will focus on identifying the sources of perched water in the northern part of INTEC near the tank farm.

6.2.11 Demobilization

Once drilling has been completed and instrumentation has been placed in the wells, the subcontractor will begin demobilization of their equipment. Demobilization includes the physical removal of all equipment from the site, restoration of disturbed areas, and general cleanup of all work areas. Once demobilization is complete, the work areas should be as close to original condition as possible. Phase I well drilling will precede Phase II drilling by approximately 1 year. The two phases will be treated as separate and distinct contracts with separate demobilization operations required.

6.2.12 Contingent Remedy Phase

The need for recharge control measures and/or additional monitoring wells will be assessed only after the results of Phase I and Phase II activities are finished, the percolation ponds have been relocated, and the 5-year monitoring of the perched water zones have been completed.

6.3 Evaluation of Tracer Study and Phase I Results Against Performance Measurement Points

Phase I activities are primarily designed to refine the final design of the monitoring network used in Phase II to evaluate the remedial action effectiveness. As such, there are no specific remedial action performance measurement points associated with the Phase I activities.

However, the baseline sampling and tracer study which are components of Phase I actions will also be utilized to support the analysis of the Phase II monitoring results. Both the baseline sampling results and the tracer study have been incorporated into an updated conceptual model for contaminant transport in the subsurface at INTEC (DOE-ID 2003). This information will support understanding of the contaminant distribution in the INTEC subsurface and for the migration of recharge water and interconnections of perched water bodies. This information will be utilized in the numerical modeling tasks performed to evaluate the Phase II moisture content and COC concentration trends.

6.4 Evaluation of Phase II Results Against Performance Measurement Points

The primary performance measurement point for the Group 4 remedial action, as discussed in Section 2 above, is meeting drinking water standards in the SRPA outside the INTEC security fence in the year 2095. Furthermore, the selected remedy in the ROD, for Group 4, states that, "If after five years (following relocation of the INTEC percolation ponds), the perched water zones are not draining out as predicted by the RI/FS model then additional recharge controls will be implemented" (DOE-ID 1999). Because the performance measurement point does not occur until 2095, the evaluation of the Phase II results will include a numerical modeling task performed to generate risk predictions based upon the observed trends in moisture content and COC concentrations during the five year monitoring period leading to the contingent remedial action decision.

The data obtained under this monitoring program will be evaluated and incorporated into an updated WAG 3 numerical model to determine if the moisture contents and COC fluxes have been reduced sufficiently to meet the COC concentration limits at the INTEC security fence line in 2095. As discussed above, the numerical modeling tasks will incorporate the results of the baseline sampling and tracer tests performed during Phase I, as well as the geochemical study and engineering/water-balance study, moisture monitoring, and COC concentration data from both the perched water and Group 5 SRPA sampling. All new information collected during the Phase I or Phase II activities will also be incorporated into the numerical modeling and long-term risk predictions. Investigation of newly identified contamination in the vadose zone may be required to support the modeling and compliance with the RAOs.

A summary of the process to develop the numerical simulation of the Phase II monitoring data follows:

1. Refine the existing conceptual model describing the physical and chemical processes that will be represented in the simulation model.

2. Refine the existing parameterization of the model that meets the conceptual model assumptions. The OU 3-13 RI/FS model parameterization will be the primary source for this initial parameterization.

3. Calibrate the model. The calibration will consist of two parts. The first part will be an evaluation of the model structure that will determine which attributes of the subsurface model have the largest effect on predicted peak concentrations in the aquifer. The second part will consist of adjusting parameter values to improve model agreement to the field data.

4. Summarize the sensitivity and uncertainty analysis and how the results will be used.

5. Summarize the predictive model results and COC concentration predictions at the performance measurement point in 2095.

6.5 Field Oversight and Construction Management

The DOE-ID remediation project manager will be responsible for notifying the EPA and IDEQ of major project activities (e.g., project startup or closeout) and other project activities it deems appropriate. DOE-ID will serve as the single interface point for all routine contact between the EPA, IDEQ, and BBWI.

BBWI is responsible for field oversight and construction management services for this project and will provide field support for health and safety, quality assurance, and landlord services. A project organization chart and associated position descriptions are provided in the project HASP (Appendix H).

Visitors to the project who wish to observe remediation activities must meet badging and training requirements necessary to enter INEEL and INTEC facilities. Project-specific training requirements for visitors are described in the project HASP (Appendix H).

6.6 Project Cost Estimate

A summary of project costs is provided in Appendix M. The costs will be revised for each submittal of the work plan to reflect new information and/or comments, as appropriate.

6.7 Project Schedule

The remedial action-working schedule for Group 4 is presented in Appendix L and includes all project tasks from preparation of this work plan through performance of the remedial action and submittal of the Monitoring Report Decision Summary Report. Administrative and document preparation and field activities are based on a 40-hour workweek. This schedule assumes concurrent contractor and DOE-ID document reviews. There is no schedule contingency for delays due to slow or late document reviews, or for field activities impacted by adverse weather conditions.

6.8 Remedial Action Reporting

The following reports will be prepared and submitted in compliance with RD/RA Work Plan reporting requirements:

1. **Monitoring Well and Tracer Summary Report**: A secondary document for Group 4 that was finalized in March 2003 and provides the results from the initial well installation and tracer studies. This report contains recommendations for additional Phase II activities (DOE-ID 2003).

2. **Monitoring Report/Decision Summary Report**: A primary document that uses data from Phases I and II activities to document the data, rationale, and justification for decisions concerning the need for a third phase of contingent remedial actions. An updated Operations and Maintenance Plan will be included as a part of this report. This report will function as the Remedial Action Report for Group 4 activities.

6.9 Health and Safety

The project HASP was prepared specifically for the tasks and conditions expected during implementation and execution of this project. It is provided in Appendix H of this document. The purpose of the HASP is to clearly identify the associated hazards from project tasks and the manner these hazards will be eliminated or mitigated by using engineering controls, administrative controls, personnel protective equipment, and work practices and procedures.

The HASP, which may be updated as site and project conditions dictate, includes the following elements:

- Project scope and objectives
- Hazard identification and mitigation
- Exposure monitoring and sampling accident and exposure prevention
- Personal protective equipment
- Personnel training
- Site control and security
- Occupational medical surveillance
- Key site personnel responsibilities
- Emergency response plan
- Decontamination procedures
- Record-keeping requirements.

6.10 Waste Management

The following waste streams are expected to be generated as a result of the Group 4, Perched Water, remedial action activities:

- Personal protective equipment
- Purge water
- Decontamination wastes/water
- Noncontaminated project waste
- Drill cuttings
- WCF purge water, drill cuttings, and sampling waste.

Ultimate disposition of these wastes will depend on whether they are radionuclide-contaminated. A description of these waste streams and their appropriate disposition are provided in the project Waste Management Plan (see Appendix F).

6.11 Quality Assurance

The quality level designations included in Appendix A have been prepared for all Group 4, Perched Water activities. A Quality Level 3 has been deemed appropriate for this project. All design, procurement, and construction activities will be in accordance with the Quality Level 3 designation.

Quality Assurance and Quality Control requirements for all sampling activities associated with this project will be controlled by the Site-approved Quality Assurance Project Plan (QAPjP) for environmental restoration projects. The approved QAPjP for all environmental restoration projects at the INEEL is provided in Appendix C of this document.

The QA objectives for measurement will meet or surpass the minimum requirements for data quality indicators established in *Quality Assurance Project Plan for Waste Area Groups 1, 2, 3, 4, 5, 6, 7, 10, and Inactive Sites* (Appendix C). The QAPjP provides minimum requirements for the following measurement quality indicators: precision, accuracy, representativeness, completeness, and comparability.

The detection limits as described in the QAPjP (Appendix C) meet or surpass the decision-based concentrations of the contaminants of concern with the exception of I-129. I-129 quantification requirement (reporting threshold) is 1 pCi/L, which necessitates a minimum detection limit of 0.1 pCi/L to identify I-129 presence with any level of confidence.

All field and nonchemical data generated in support of Group 4 activities will be captured and maintained according to the Data Management Plan (Appendix J).

6.12 Decontamination

Upon completion of well drilling activities, exposed surfaces of equipment used for well drilling and sampling will be decontaminated at designated decontamination areas in each work zone by brushing and wiping until all visible traces of soil and soil-related staining have been removed. If additional decontamination is necessary that would generate a liquid waste, the Staging, Storage, Sizing, and Treatment Facility decontamination facility would be used. Decontamination issues are extensively addressed and discussed in the Waste Management Plan (Appendix F) and the Phase I FSP (Appendix B) of this document.

6.13 Long-Term Monitoring

The project Long-Term Monitoring Plan (Appendix E) identifies routine and/or periodic monitoring, sampling/analysis, inspection, and maintenance requirements to be implemented following the completion of Group 4 well drilling/completion activities. The plan also identifies the requirements for periodic reporting and identification of end-points for long-term. Maintenance activities are expected to continue until the end of FY 2014. The long-term plan may be revised as necessary to incorporate changes and additions identified during the implementation of the plan.

6.14 Spill Prevention/Response Program

Any inadvertent spill or release of potentially hazardous materials (i.e., equipment fluids) will be subject to the substantive requirements contained in applicable company policies and procedures. For additional detail, see Appendix G. Section 4.2 of the HASP identifies methods and practices for spill prevention and direction on preventing personal exposure to spills. Section 10.4.2.4 of the HASP identifies spill response and associated notifications necessary to ensure a quick and effective containment and cleanup of spilled materials.

Handling of the material and/or substance shall be in accordance with the recommendations of the applicable material safety data sheets, which will be located at the project site(s). In the event of a spill, the emergency response plan outlined in the project HASP will be activated (Appendix H). All materials/substances at the worksite shall be stored in accordance with applicable regulations in approved containers.

6.15 Other Procedures Relevant to Remedial Action Activities

Appendix K provides a complete listing of all applicable management control procedures that are relevant to remedial action activities at INTEC. A complete copy of each will be provided under a separate transmittal, for informational purposes only.

7. REPORTING

The working schedule and milestone list that details the timeframes and goals for the submission of each deliverable are listed in Appendix L. This schedule is a working schedule, which indicates the best effort to perform the Group 4 activities prior to the enforceable milestones and target dates. Table 7-1 provides a summary of the RD/RA deliverables enforceable milestones for primary documents and target dates for secondary documents highlighted. These milestones and target dates are within the overall FFA/CO schedule for the INEEL and consistent with the OU 3-13 RD/RA SOW. Requests for extensions to the enforceable schedule will be submitted to the Agencies for concurrence and approval.

Section XXII-22.1 of the FFA/CO (DOE-ID 1991) states that, "Consistent with Section 121(c) of CERCLA, 42 U.S.C. 9621(c), and in accordance with this Agreement, U.S. DOE agrees that EPA may review response action(s) for OUs that allow hazardous substances to remain on-site, no less often than every five (5) years after the initiation of the final response action for such OU to assure that human health and the environment are being protected by the response action being implemented." The RD/RA Guidance, (DOE-ID 1994) states: "The five-year review process involves an evaluation as to whether the selected remedy remains 'protective', in light of possible new standards, DOE-ID will evaluate, on a case-by-case basis, significant new requirements to ensure that the selected remedy does in-fact remain protective."

The CERCLA 5-year review will be completed five years from the start of the RA, and repeated every five years thereafter. The Monitoring Report/Decision Summary will be completed 5 years after relocation of the percolation ponds and will document the data, rationale, and justification for decisions concerning contingent remedial actions based on the results of the existing remedial action.

Table 7-1. Summary of primary and secondary deliverables and enforceable milestones.

Deliverable	Document Type	Enforceable Milestone	Target Date
Draft Water Balance Engineering Study	Secondary	NA	11/18/03
Draft Phase II Monitoring Summary Report for Year 1	Secondary	NA	11/06/03
Draft Phase II Monitoring Summary Report for Year 2	Secondary	NA	11/09/04
Draft Phase II Monitoring Summary Report for Year 3	Secondary	NA	11/04/05
Draft Phase II Monitoring Summary Report for Year 4	Secondary	NA	11/08/06
Monitoring Report/Decision Summary Report	Primary	04/21/08	—

8. REFERENCES

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40 CFR 230.10, 2002, "Restrictions on discharge," *Code of Federal Regulations*, Office of the Federal Register, July 2002.

40 CFR 300.430, 2002, "Remedial investigation/feasibility study and selection of remedy," *Code of Federal Regulations*, Office of the Federal Register, July 2002.

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Appendix A

Quality Level Designation

(The document that is the subject of this appendix was provided as an attachment to the original deliverable.)

Appendix B

Field Sampling Plan for Operable Unit 3-13, Group 4, Perched Water Well Installation

DOE/ID-10745
Revision 2

(This document has been submitted under a separate cover.)

Appendix C

Quality Assurance Project Plan for Waste Area Groups 1, 2, 3, 4, 5, 6, 7, 10, and Inactive Sites

DOE/ID-10587
Revision 7

(This document has been submitted under a separate cover.)

Appendix D

Tracer Test Plan for Operable Unit 3-13, Group 4, Perched Water

DOE/ID-10762
Revision 0

(The document that is the subject of this appendix was provided as an attachment to the original deliverable.)

Appendix E

Long-Term Monitoring Plan for Operable Unit 3-13, Group 4, Perched Water

DOE/ID-10746
Revision 0

(The document that is the subject of this appendix was provided as an attachment to the original deliverable.)

Appendix F

Waste Management Plan for Operable Unit 3-13, Group 4, Perched Water

DOE/ID-10749
Revision 2

(This document has been submitted under a separate cover.)

Appendix G

"Spill Prevention/Response Plan"

PLN-114
Revision 14

(The document that is the subject of this appendix was provided as an attachment to the original deliverable.)

Appendix H

Health and Safety Plan for OU 3-13, Group 4, Perched Water Project

INEEL/EXT-2000-00257
Revision 1

(This document has been submitted under a separate cover.)

Appendix I

Storm Water Pollution Prevention Plan

(The document that is the subject of this appendix was provided as an attachment to the original deliverable.)

Appendix J

Data Management Plan for Field and Nonchemical Data from the Operable Unit 3-13, Group 4 and Group 5, Well Installation and Monitoring Projects

DOE/ID-10768
Revision 0

(The document that is the subject of this appendix was provided as an attachment to the original deliverable.)

Appendix K

Procedures Relevant to RA Activities

(The documents that are the subject of this appendix were provided as an attachment to the original deliverable.)

Appendix L

Project Schedule

(The document that is the subject of this appendix was provided as an attachment to the original deliverable.)

Appendix M

Project Cost Estimate

(The document that is the subject of this appendix was provided as an attachment to the original deliverable.)

Appendix N

Field Sampling Plan for Operable Unit 3-13, Group 4, Geochemical Study for Perched Water Source Identification

DOE/ID-11100
Revision 0

(This document has been submitted under a separate cover.)

Appendix O

Supplemental Work Plan for Tc-99 Evaluation in Groundwater, Waste Area Group 3, Group 4, Perched Water

ICP/EXT-03-00029
Revision 0

(This document has been submitted under a separate cover.)